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ABSTRACT

An examination of the concept "environment" leads to a number of questions that must be answered to reduce ambiguity of any particular use of the term: "What entity in the Universe is being used as the referent for 'environment'?" "What is the purpose of considering that entity's environment?" "What parts of the Universe external to the entity used as the referent are relevant, that is, have an effect, related to the purpose, on the entity?" These questions need to be applied to any use of "environment," including "environmental education." When "environmental education" is being discussed, ambiguity can be reduced further if the type of education--in, about, or for (the preservation of) the environment, or any of the combinations of two or more of these types--is specified. (Education for and education about the environment are distinguished by their goals; education in the environment is a pedagogic technique.) A transdisciplinary approach, based upon a strong foundation in the separate disciplines, is most likely to be effective in achieving goals for the environment. The arguments are illustrated by reference to existing definitions and programs and by an example of the possible nature of a curriculum based upon the effects of external parameters on an individual's well-being. (AL)

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ENVIRONMENT AND ENVIRONMENTAL EDUCATION:
CONCEPTUAL ISSUES AND CURRICULUM IMPLICATIONS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Arthur Maurice Lucas, B.Sc., B.Ed.

* * * * *

The Ohio State University
1972

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Research on "inquiry" with particular reference to biology teaching. In "Biological Education in Australian Secondary Schools," Op. Cit., 208-220,1970.

FIELDS OF STUDY

Studies in Science Education. Professor Robert W. Howe.

TABLE OF CONTENTS

Page
ACKNOWLEDGEMENTS ii

VITA iii

LIST OF FIGURES viii

INTRODUCTION 1

Chapter

I. BACKGROUND AND OVERVIEW 5

Pressures for Environmental Education
Educators' Difficulties
Overview

II. GENERAL CONSIDERATIONS. 21

Choice of Referent
Relevant Environmental Components
Summary

III. REFERENT OF THE ENVIRONMENT 37

Human Referent
Individual or Species?
Values and the Choice of Referent
Referent for this Study
Summary

IV. RELEVANT COMPONENTS OF THE ENVIRONMENT. 67

Non-Human Components of The Environment
Other People as Components of The Environment
Aberrant Case
Summary

V. INTERPRETATIONS OF 'ENVIRONMENTAL EDUCATION' 98

Characteristics of the Classes of Environmental Education

Characteristics of the Basic Classes of Environmental Education
Characteristics of the Compound Classes of Environmental Education

Examples from the Literature

Introduction
Existing Definitions and Program Goals
Summary

VI. CHOOSING AN ENVIRONMENTAL EDUCATION PROGRAM 130

Purpose and Referent
Relevant Environmental Components
Class of Environmental Education Program
Summary

VII. 'BALANCE OF NATURE' AND 'POLLUTION' IN AN ENVIRONMENTAL EDUCATION CURRICULUM 181

Uses of 'Pollution'
What Counts as 'Pollution'?
'Pollution' is an Incidental Consequence of Other Actions

VIII. A CURRICULUM SEGMENT 198

Content

Requirements for Food Production

Skills

IX. CURRICULUM IMPLICATIONS. 218

Transdisciplinary Nature of Environmental Education
Courses in Environmental Education?
Recent Trends
Questions for Curriculum Developers
Justification

BIBLIOGRAPHY 237

LIST OF FIGURES

Figure	Page

1. Schematic Representation of the Assumptions Underlying Southern's Conception of Environmental Education 147

2. Schematic Representation of the Assumptions Underlying the Stapp _et al_. Conception of Environmental Education 148

3. Schematic Representation of Cyclic Model Relating Attitudes, Knowledge, and Action 149

4. Partial Network of Interrelationships Between Factors Contributing to a Supply of Energy for Cell Functions 200

5. Partial Network Interrelating Requirements for Human Food Production 202

6. Partial Network of Factors Needed to Ensure a Supply of Ions for Plant Growth 205

INTRODUCTION

Definitions of "environment" and "environmental education" abound. Many are, in Scheffler's terminology, stipulative: "environment" is defined in a particular way by an author, who may say that within a particular context the term is to be understood to be equivalent to another term or short description.[1] For example, a geneticist may state that for his purposes, "'environment' refers to the source of all influences on an organism's phenotype other than those derived directly from the inherited material." This definition then allows his readers or students to interpret his references to "heredity and environment," but does not necessarily imply that when an ecologist or sociologist uses the term he ought to mean exactly the same thing. The stipulation only applies under the specified circumstances.

Stipulative definitions are not offered in this volume. No useful purpose would be served by stipulating yet another meaning of "environmental education," for such a step does not clarify the existing usage of the term. Instead, some "descriptive definitions" are provided to explain the usage of the terms;[2] for example two chapters are used to explain the meaning of 'the environment' in normal and professional language. This study attempts to explain 'environment' and 'environmental education' by mirroring current usage, and to extract from the explanation the general principles that are used to determine the appropriateness of applying the terms to particular cases.

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[1] Israel Scheffler, The Language of Education (Springfield, Illinois: Thomas, 1960), p. 13.

[2] Ibid., pp. 15-18.

The explanations lead to a number of questions that must be answered when considering 'environment' or 'environmental education'. A particular educator's answer to these questions, some of which are value questions, determines the type of program implied by his use of the terms. To illustrate the argument one particular set of answers is given and justified from my own value position. That is, as well as providing a general descriptive definition of "environmental education," I also supply one of many possible "programmatic definitions"[3] that are consistent with my analysis of 'environment' and of 'environmental education'.

The particular program of education implied by the position I take is one suitable for general education. That is, for education providing the knowledge and skills that citizens could reasonably be expected to have. This need not be confined to any particular level of a person's formal school experience, for education of a similar type can be provided for adults, via the mass media and through specific adult education agencies. I would recommend a different programmatic definition consistent with my analysis if asked to propose an educational program for specialists concerned with environmental control, regulation, or investigation.

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[3] Ibid., p. 19: "A programmatic definition . . . may perhaps be said to convey the practical consequence itself, rather than merely to express a premise capable of yielding it [the practical consequence] under suitable conditions."

My personal positions are identifiable in the text by the use of the first person singular "I." Elsewhere in the text the editorial "we" is used.

One other convention used requires some explanation. When discussing the literal sense of 'environment' it is necessary to indicate whose environment is being considered. That is, which entity in the Universe is being used as the reference point for 'environment'? If we are speaking of the environment of Lake Superior, 'Lake Superior' is the entity being used as the referent for 'environment'. The use of the word "referent" is not intended to imply that the reference theory of meaning is necessarily accepted.[4]

In this study a number of examples from the literature are used to illustrate points. However, no claim to exhaustive citation is made. The literature is voluminous, with many authors reflecting the same usage of the terms. In most cases only one or two examples of each position are cited, but there is no intent to imply that these are the major advocates of that position, or indeed, that the author still holds the viewpoint expressed in the source cited. For example, Roth (personal communication) no longer holds the view discussed in Chapter IV. Similarly, the frequency of citation of a particular position does not reflect its frequency in the literature: the rarest usage may be cited as many times as representative positions of more prevalent interpretations.

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[4] L.M. Brown, General Philosophy in Education (New York: McGraw Hill, 1966), p. 3-8, discusses this theory and its limitations. "Referent" in this study does not necessarily mean a "thing symbolized by / a / word."

CHAPTER I

BACKGROUND AND OVERVIEW

The 1970's have been called the "Environmental Decade" during which a number of ills must be cured if environmental resources are to be preserved.[1] The United States Congress has required agencies of the Federal Government to use "all practicable means" to

> encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; /_and/ to enrich the understanding of the ecological systems and natural resources important to the Nation.[2]

The United States is not alone in reflecting developing public concern with problems of environmental deterioration. A number of countries (e.g., Great Britain, France, Australia) have established government departments concerned with the environment, and the United Nations sponsored the Conference on the Human Environment during

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[1] U.S., Congress, House of Representatives, Committee on Government Operations, The Environmental Decade (Action Proposals for the 1970's): Hearings Before the Conservation and Natural Resources Subcommittee, 91st Congress, 2d Session, 1970.

[2] U.S., National Environmental Policy Act of 1969, Public Law 91-190, January 1, 1970.

1972.[3]

Pressures for Environmental Education

During periods such as this when long-term national difficulties are forseen, public education is expected to play an important role in solving or ameliorating the problems. Sometimes, as in the extensive government support for United States science and mathematics education catalyzed by Russian astronautical prowess, education is expected to produce specific cognitive results. In the example cited, education was expected to provide the cognitive skills necessary to create the "greater pool of scientifically minded citizens and of scientists /̲that̲/ is needed to enable the free world to regain and then maintain a position of scientific superiority."[4] In other cases there are less urgent, more indirect outcomes that education is expected to ensure.

Changes in the organization of education as well as in the overt curriculum are sometimes expected to assist the development of more desirable social attitudes, especially where the existing school milieu is held to be contrary to the national interest. Typically such attempted changes occur in the industrialized nations, but they are not restricted to them. Three examples illustrate the reliance on education for social change: the movement toward abolition of the so-called "elitist" British grammar schools by "comprehensivization" of secondary education; the denial of the doctrine of "separate but equal" racially segregated schooling in the United States; and the merging of education, research, and production in China to emphasize egalitarianism and make all three responsive to the needs of the everyday world.

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[3] See The Human Environment. Vol. II: Summaries of National Reports Submitted in Preparation for the United Nations Conference on the Human Environment. Environment Series 201 (Washington D.C.:Woodrow Wilson International Center for Scholars, 1972), pp. 94, 25, 3.

[4] Joseph F. Roucek, (ed.), The Challenge of Science Education (New York: Philosophical Library, 1959). Editor's preface, p. viii.

It is not exceptional, therefore, that when much attention is directed toward perceived dangers to "the ecology" and "the environment" strong pressures toward using education to help restore and maintain a viable life-support system have developed. The pressures come from government and from advocates of a variety of disparate positions concerning environmental needs. The United States Congress, for example, stated that

> the deterioration of the quality of the Nation's environment and its ecological balance . . . is in part due to poor understanding of the Nation's environment and the need for ecological balance; / and/ that presently there do not exist adequate resources for educating and informing citizens in these areas, and that concerted efforts in educating citizens about environmental quality and ecological balance are therefore necessary.[5]

Ehrlich and Commoner, although they have carried on a sometimes acrimonious debate concerning the causes and remedies of the "environmental crises" both see education as a necessary component of any solution.[6]

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[5] U.S., Environmental Education Act, Public Law 91-516, October 30, 1970.

[6] Paul R. Ehrlich, The Population Bomb, (New York; Ballantine, 1971), p. 127; Barry Commoner, The Science Teacher 39(5):18-24, 1972, p. 24.

Some writers give education an even more important role than that implied by the extract quoted from the Environmental Education Act. Boyden, for example, states that

> because so much depends on a rapidly widening understanding of the nature of the environmental predicament and of the socio-biological processes it is clear that our educational institutions must be placed at the top of the list of key groups with special responsibilities /for providing solutions to the problems resulting from the intensified interactions between cultural and natural processes/.[7]

With such widespread support environmental education is clearly an established concern, even though there is some evidence that the environmental awareness upon which the movement is based is not as all-pervasive as many commentators would have us believe. Tognacci et al. have found that "the ability of the ecology movement for unifying a diverse constituency has perhaps been overrated."[8]

Despite the possible lack of concern by all parts of United States society for the preservation and restoration of the environment, there has been sufficient pressure for "environmental education" to have become a common label for activities in a majority of the U.S. public schools. For example, in a survey of a sample of public elementary schools, proportionally stratified on enrollment, in the Far West and Great Lakes regions of the United States, 82% of the principals who responded reported that environmental or conservation education was taught in their schools in 1970-71. It was rarely taught as a separate subject: the highest frequency was in the state of Washington where a separate "course"[9] was reported in 10.8% of the grade six classes. In a companion survey of secondary schools in the same region principals reported that, in tenth grade, 9.4% of the schools offered a separate course; 44.6% taught environmental/conservation education with science; 13.5% taught it with social science; and 11% reported including environmental/conservation education in two or more subjects, including science.[10]

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[7] Stephen Boyden, in Education and the Environmental Crisis, ed. Jeremy Evans and Stephen Boyden (Canberra: Australian Academy of Science, 1970), p. 18.

[8] Louis N. Tognacci et al., Environment and Behavior 4:73-86, 1972.

Educators' Difficulties

The presence of environmental education in the schools is no guarantee that any change will occur in the condition of the environment. There is little evidence that the post-Sputnik surge in science and mathematics education has made a direct contribution to achieving the symbolic restoration of American technology to world leadership by landing man on the moon; early childhood "compensatory education" in the United States has had equivocal results; and Chinese educational reorganization was disrupted during the Great Proletarian Cultural Revolution, apparently because of little success in achieving the social goals set earlier.[11] If these uses of content, structure, and setting of education to achieve relatively well-defined ends have not been successful, "environmental education" is unlikely to fare much better, particularly in light of the difficulties it faces.

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[9] Jerrold W. Maben, "A Survey of Science Teaching in the Public Elementary Schools of Two Selected Regions of the United States During the 1970-1971 School Year." (Ph.D. dissertation, The Ohio State University, 1971).

[10] Chin Long Fay, "A Survey of Science Teaching in the Public Secondary Schools of the Great Lakes and Far West Regions of the United States in the 1970-71 School Year." (Ph.D. dissertation, The Ohio State University, 1971). Data recalculated, using the number of secondary schools with a tenth grade as a base, from Tables 49-56. The number of schools in the subsample was determined from Tables 3 and 4.

Substantive Disagreement Among Experts. In addition to being seen as a panacea for almost all social and bio-social ills, environmental education is beset with problems of disagreement among the "experts." Although the statements quoted earlier from Boyden and the Environmental Education Act imply that there are well established principles of ecological balance, of resource conservation, and of sociobiological interactions, which can be used to provide solutions to "the environmental problems" there is, in reality, disagreemant about the worth of solutions that have been proposed.

Ehrlich and Holdren, for example, believe that population growth is the most important component of environmental deterioration, and that we must begin solving it "at once."[12] Contrast this position with that of Coale. While acknowledging the eventual necessity of influencing Americans' perceptions of ideal family size, he believes that there is "no need for haste," provided that contraception and abortion are freely available to eliminate "unwanted" births. The resulting gradual increase in the United States population during the next generation "would not be a major addition to the problems we already face."[13] Coale feels that the dangerous changes in the biosphere (e.g., contamination of the air and water by industrial and domestic waste, and insecticide and fertilizer accumulation) can be properly attributed to a "high level of economic activity and the use of harmful technological practices."[14] His recommended actions are, therefore, economic and include charges (taxes) for the present externalities of production (air and water pollution, for example).[15]

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[11] See Editors, Phi Delta Kappan 51:2-7, 1969; Richard H. Davis, Education and Urban Society 4:234-248, 1972; Stewart E. Fraser and John N. Hawkins, Phi Delta Kappan 53:487-500, 1972.

[12] Paul R. Ehrlich and John P. Holdren, Science 171:1212-1217, 1971, p. 1217.

As well as disagreements about priorities, such as that between Coale and Ehrlich and Holdren, there are also conflicts about the solution to specific problems. These solutions may be applications of "environmental science" or they may be social, economic, or political actions. In some cases actions initiated by one group to alleviate a particular environmental problem can aggravate another. A recent example of disagreement about solutions is seen in the conflict between the recommendations of the Environmental Protection Agency and the Surgeon General concerning the use of low-phosphate detergents. On the one hand, non-phosphate detergents may help slow eutrophication of lakes; on the other, the caustic substances used as replacements can cause dermatological problems for users.

The introduction of the so-called "miracle grains" into the developing countries also illustrates the possibility of solving one problem, that of low rice and corn yields from the unselected varieties typically used in village agriculture, but simultaneously creating other problems. As well as the danger of a regional monoculture succumbing to a pandemic similar to that in the United States corn crop in 1970, when a virulent race of Helminthosporium maydis attacked crops based upon the Texas male-sterile cytoplasm strains, economic problems may develop following the introduction of new grains. The new varieties require irrigation, fertilizer, and additional labor, necessitating subsidies for growers. This has, in some cases, apparently priced the grain out of the reach of local consumers.[16]

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[13] Ansley J. Coale, Science 170:132-136, 1970, p. 136.

[14] Ibid., p. 132.

[15] Ibid., p.

Such fundamental disagreements in policy and on the worth of solutions to particular problems create difficulties for environmental education. If educators intend to inculcate particular sets of behaviors as solutions to specific problems (e.g., consumer buying patterns as a solution to the use of phosphate-rich detergents) they need to be certain that the behaviors inculcated are an optimum solution. If it is later found that these behaviors are, in fact, inappropriate in the long run, and the public has to be "re-educated" frequently, the credibility of future proposed solutions will be severely reduced. Public resistance to phasing out mobile mass X-ray vans, no longer thought medically useful for the eradication of TB, is a current example of the effect of inducing a widespread attitude in the populace.[17]

Conceptual Disagreements. In addition to the issue of identifying problems and solutions, there are conceptual difficulties that must be resolved. These difficulties are outlined here and discussed in detail in succeeding chapters.

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[16] William C. Paddock, BioScience 20:897-902, 1970. p. 898.

[17] Bryce Nelson, Science 174:1114-1115, 1971. p. 1115.

There are fundamental disagreements about the nature of 'environment' between advocates of environmental education. Most attention is paid to the bio-physical setting of man, with the nature of the tripartite interactions between man, other organisms, and the non-living world being emphasized.[18] Some authors extend 'environment' to include the cultural setting of man as well as his biophysical surroundings; thus ecology, history, psychology, and sociology are all seen as disciplines contributing to environmental education.[19]

Whether or not the cause of the disagreement in scope is a "reluctance" to define terms, the difficulties that the vagueness of the "environmental education" discourse leads to have been indicated by Helgeson et al.:

> The reluctance of persons concerned with environmental problems and environmental education to define the area of their concerns has led to a diffuseness in the discussion which is unlikely to lead to useful analysis of the problems or to the successful resolution of them.[20]

In addition to the question of the compass of 'environment' it is necessary to examine the choice of the entity whose environment is being considered. In most discussions of environmental problems and of environmental education it is assumed, often implicitly, that it is the environment of man that is being considered. However, it is not usual to specify whether it is the environment of each individual--of Tom, of Dick, or of Harry--or of groups of individuals. Groups may be of any size. For instance, family units--the Does, the Smiths, the Joneses; national units--the British population, the French, residents of the United States; or the species Homo sapiens.

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[18] See, for example, Ronald B. Linsky, The Science Teacher 38 (1):16-18, 1971; Roy C. White, The Science Teacher 37(8):38-40, 1970; and Beverly O'Neill, in Education and the Environmental Crisis, ed. Jeremy Evans and Stephen Boyden (Canberra: Australian Academy of Science, 1970).

[19] See, for example, Edward J. Kormondy, American Biology Teacher 33:15-17, 1971.

[20] Stanley L. Helgeson et al., Final Report OEG-0-71-2732: A Review of Environmental Education for School Administrators (Columbus, Ohio: U.S. Department of Health, Education, and Welfare, Office of Education, National Center for Educational Research and Development, 1971). p. 4.

Few writers have made this distinction, and even when it appears to have been made the true distiction may not have neen recognized. Wang, for example, has pointed out that a "total environment considers ALL conceivable and/or measureable factors affecting man as an individual and his society as a whole."[21] Here the implication is that the environment includes factors impinging upon individual men and upon society. That is, he appears to be using two different senses of 'environment' simultaneously. The first referent is an individual, the second is the human society. However, since Wang's examples of law and politics are components of society, the entity that he is actually considering is probably the individual.

The emphasis on the distinction being essayed here is not merely pedantic formalism, hairsplitting to provide ammunition to knock down a straw man. A planner, seriously concerned with the entity Homo sapiens, rather than individual members of that set, would take quite a different viewpoint from a person whose planning was predicated upon *individual* rights, liberties and happiness. The point is discussed further in Chapters III and IV, where the social and educational implications of the choice of referent are considered.

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[21] J.Y. Wang, in Man and His Environment:Interaction and Independence. ed. J.Y. Wang (San Jose: San Jose State College, 1969). p. 148.

Values and Attitudes. It is impossible to escape from a consideration of values in discussions of environmental questions. They arise particularly in connection with the choice of the human unit whose environment is being considered, and in the purpose of conducting environmental education, but there are related questions that arise when the consequences of alternate possible remedial environmental controls are being weighed. Value questions are discussed in later chapters. In Chapter III the possibility of inanimate objects having value, in and of themselves, without human reference, is discussed. This is presently a live issue, being raised by some of the organizations using legal action in attempts to preserve Wilderness Areas intact[22] and being implicit in some educational writings that attempt to inculcate a bio-centric value. (The bio-centric position holds that life on Earth, in any form, has value merely because it is living). Examples of this position, not always articulated in this form, can be found in Harrar's discussion of a "new ethic of ecological responsibility [which] must extend far beyond [concern for one's descendants]. It must embody . . . the total responsibility for . . . *all* life, in its varied and diverse forms."[23] It is also a value espoused by some student respondents in a study including data on student attitudes and goals for biology instruction.[24]

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[22] See the news article "Sierra Club Foiled in High Court," *Science* 176:494, 1972, for comment by Justice Douglas suggesting that trees and rivers have independent status.

Teachers need to be aware of the values implicit in their curriculum material, and to be alert to the ethical positions that they are exhibiting during their environmental education activities.

The disagreement between advocates of different forms of environmental education are not solely reflections of the different interpretations of 'environment'. Many writers emphasize the inculcation of a particular set of attitudes to each environmental problem recognized.[25] Others feel that specific manipulation of attitudes is not a legitimate role for public education in a free society; they believe that the aim should be to produce "informed, intellectually capable, socially concerned individuals capable of making rational, objective judgements for themselves in each case, now and in the future."[26]

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[23] J. George Harrar, in Outlines of Environmental Education, ed. Clay Schoenfeld (Madison, Wisconsin: Dembar Educational Research Services, 1971), p. 63.

[24] Effie D. Best, "An Exploratory Study of the Correlates of Student Decision Making in the Secondary School Biology Laboratory," (Ph.D. dissertation, The Ohio State University, 1970). See p. 135.

[25] See, for example, Ronald B. Linsky, The Science Teacher 38 (1):16-18, 1971; Roy C. White, The Science Teacher 37(8):38-40, 1970; Edward J. Kormondy, American Biology Teacher 33:15-17, 1971; and Earle Hacket, in Education and the Environmental Crisis.

[26] David G. Morgan, in "Biological Education in Australian Secondary Schools," ed. A.M. Lucas (Duplicated report presented to the Australian Academy of Science, 1970), p. 93. Disagreements concerning goals for attitude inculcation are discussed in Chapters V and VI, using Morgan's position as one example.

Generality of Aims. In addition to the differences in emphasis on attitude formation with respect to particular environmental or social problems, educators also differ in the degree of generality they advocate for environmental education programs. Some are relatively parochial; others stress general principles. Stapp, using "environmental encounters" designed to link relevant ecological, economic, social, technological, and political information about a local environmental condition or situation, is representative of the first approach.[27] Roth *et al.*, who have produced a taxonomic list of environmental management concepts that relate to the "scientific, humanistic, and technological disciplines," and which a person needs to know in order "to function as an effective citizen," place more emphasis on general, more-or-less universal principles.[28]

Overview

In the following chapters the nature of 'environment' and 'environmental education' are considered. In Chapter II we seek criteria that may be used to establish the appropriate referent for 'environment' and those that can help determine whether any particular part of the Universe, other than the entity being used as referent, is relevant when considering the entity's environment.

Chapters III and IV examine the use of 'environment' in an unqualified way to refer to '*the* environment'. In Chapter III the referent of 'the environment' is shown to be human, but variations exist in the actual entity used as referent for 'environment': sometimes it is the individual human; at others it is a group--often the species, but it can be the nation or other group. In this discussion of referent for 'the environment' particular attention is paid to the work of two prominent authors, Paul Ehrlich and Barry Commoner. The debate they have conducted illuminates some of the differences in the entity used as referent, and helps clarify the discussion of the importance of the choice. Some implications of choosing either of the two extreme human entities, Homo sapiens or the individual, are discussed in this chapter, and reasons for considering the individual's environment in preference to that of the species are advanced.

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[27] William B. Stapp, *Journal of Environmental Education* 2(1):35-41, 1970.

[28] Robert E. Roth *et al.*, *Technical Report No. 126*, Wisconsin Research and Development Center for Cognitive Learning, 1970, p. 4.

In Chapter IV criteria for deciding whether any particular part of the individual's total environment counts as part of the environment in which he finds himself are established. Criteria that satisfactorily identify non-human components of the total environment included in the environment are not useful in assessing the status of 'other people' as parts of the environment of an individual, for, except in one special case, 'other people' are not considered part of the environment.

A large number of possible types of environmental education exist. In addition to the variations introduced by considering different referents for 'environment' and emphasizing different parts of the total environment of the entity used as referent, (the environment, the biotic environment, the cultural environment, the family environment, . . .), the analysis in Chapter V identifies seven distinct classes of environmental education. There may be education in, about, or for the environment, or any of the combinations of these primary classes. In practice, most of the examples of environmental education in the literature are representative of the combined class, 'education for and about the environment', with many of these also being in the environment, (i.e., outside the classroom). The goals of each type of program differ, and can have implications for the type of instructional methods and examples used.

Issues to be faced in the choice of an environmental education program are considered in Chapter VI. In addition to questions related to 'environment' *per se*, an educator must develop some mechanism for choosing which topics have priority for inclusion in his program; decide whether to attempt to inculcate specific attitudes toward an array of "environmental positions;" which values, if any, are to permeate his courses; and whether he must educate his students entirely in the environment. These questions of goals and techniques are identified, and one answer, based upon my decisions concerning the referent for environment and the purposes of considering environmental education, is outlined.

Chapters VII and VIII illustrate the generalized rational position chosen in Chapter VI. Chapter VII considers the implications of the position taken when considering "balance of nature" and "pollution" as possible topics for study. Chapter VIII, which describes a small segment of a curriculum based on the principles outlined in Chapter VI, is intended to be an illustration, not a definitive curriculum to be implemented without change in a school. Accordingly, little detail of specific objectives for each section is provided, and no substantial suggestions for instruction are made.

Finally, in Chapter IX, some general implications of the analysis are outlined, raising the question of the importance of curriculum development specifically for environmental education courses. Present trends in government support for preparing materials are briefly reviewed, and some cautions concerning relying on education for the solution of environmental problems are reiterated.

CHAPTER II

GENERAL CONSIDERATIONS

Many of the important general features of 'environment' are entangled with emotional, cultural and psychological positions in present usage. To avoid misunderstanding it is profitable to first examine general, noncontroversial instances of the use of the term. The conclusions drawn from these discussions can then be applied to the areas of conceptual confusion that result from the uncritical, vague use of 'environment' in political, social, and educational discourse. The examples used in this chapter are, therefore, chosen to illustrate the points made, rather than for their intrinsic importance.

In this chapter the literal sense of 'environment' is examined, particularly the criteria for the choice of referent, and methods of determining the relevance of any component of the environment of the chosen referent are analyzed.

Choice of Referent

For 'environment' to be literally sensible there must be some referent which can be distinguished within the Universe. All parts of the Universe, other than the referent, comprise the environment of that entity. Thus it is nonsensical to speak of the environment of the Universe or to suggest that an entity can be part of its own environment.

The choice of referent is arbitrary, and depends upon the interest and intent of the user. An atomic physicist, for instance, may be interested in the interaction of a pi muon with the forces that result from the presence of other particles of the same or different species in its immediate environment. A biochemist may be interested in the behavior of an enzyme system in a cell-free extract when the immediate environment of the system is modified by the addition of heavy metal ions. An ethologist may study the behavior of a brood of goslings when a model of a hawk is introduced into their immediate environment. A town planner considering the use of alternate forms of housing --single or multi-family dwellings, for instance-- may investigate the effects of these two immediate environments on the physical well-being of a community.

Although the choice of referent is arbitrary, the nature of the entity chosen can have important consequences. A dairy farmer may choose to consider the individual cow as the unit whose environment he will manipulate; or alternatively, the total herd may be the referent. If the farmer considers the individual cow as the unit, then he may be able to obtain a very high average yield of butterfat and/or milk by devoting a great deal of attention to the well-being of each individual, prescribing individual treatment corresponding to the individual differences in the members of the herd. However, he might not obtain as high a total yield for the same expenditure as another farmer who was concerned with managing the herd as a unit, and who was unaware of the characteristics of individual cows. It is quite likely that the second farmer will be able to run a larger herd than the first, and obtain an increased total yield, despite reduced individual production.

Similar considerations apply in surgery, although there is little dispute concerning the choice of entity--it is almost invariably the aggregate of living cells that comprise an individual human. Although the procedure will deprive some healthy cells of their chance of life, there is no tendency to avoid amputation of a gangrenous limb for this reason; the human, not the human cell, is the entity that surgeons normally consider.

Neither the farmer nor the surgeon need be commited to any one choice; for some purposes a different entity may be appropriate. A farmer may legitimately choose to consider one particular cow, even though he generally uses the herd as the unit. He may wish, for example, to enter one of his cows in competition at a State Fair; this would necessitate him treating it as an individual, varying its particular environment without necessary reference to the treatment of the entire herd. The surgeon, or perhaps his associated pathologists and biochemists, may sometimes have to treat an individual cell, or at least a tissue, as the unit of concern, particularly if the medical team is interested in using tissue culture techniques for diagnosis and research. In the latter case there is no need for even peripheral concern for the individual human from whom the cells originally came. The HeLa strain of human cells is now an important research tool, even though Helen Larson, the original source, is dead, and the cells are used for purposes unrelated to the health of individual humans.

It is impossible to use a purely empirical test to determine whether a particular entity is the appropriate referent for 'environment'. The choice of entity is a function of the investigator's purpose; whether the purpose is appropriate for society, or for the investigator, is a question that cannot be resolved by experiment. It is a function of the values and interests of the user and his critics. In the earlier example there was no way in which any empirical criterion could be applied to test whether the dairyman's herd or his individual cows should be the unit whose environment is manipulated, until his purpose was specified. When this is done, and we find, for example, that he is interested in maximizing the profits from his farm, we then know that the whole herd is the appropriate unit, for it is the herd that provides the profits. This does not, of course, prevent him culling relatively low producers, or cows whose potentially high yields are only obtainable with specialized, expensive attention.

The culling example indicates that we can, without any inconsistency in our argument, manipulate the structure of the entity at the same time that we manipulate its environment. A mechanical example may help clarify this point. A racing car is the entity of interest to a speedway driver. The environmental variables that are manipulable when attempting to set a new speed record include the composition of the fuel, the nature of the substrate (tarmac, salt flats, concrete), and the geographic location of the attempt (thus partially controlling prevailing winds, surface temperature, and the like). At the same time, the mechanics will attempt to alter the structure of the machine by replacing worn tires, fitting new pistons, or replacing rough body panels with more streamlined sections. The entity is clearly the car as a whole, but <ins>components</ins> of the car are changed as well as parts of its environment.

Relevant Environmental Components

The qualifying term immediate was used advisedly in the examples introducing this chapter. It would be rare, indeed, for a person to be concerned with the total environment of his selected referent. An organic chemist, for instance, is unlikely to record the phase of the moon, the relative positions of the asteroids, the thickness of the glass in the window of his laboratory, and the mass of the President of Indonesia during the conduct of an experiment. Although all these factors are parts of the Universe external to his system of chemicals, and thus part of the environment of the system, he is not likely to consider them relevant components of the system's environment. The amount of energy supplied, the composition of the walls of the reaction vessel, and the type and concentration of spectator species are, however, relevant environmental variables. Similarly, most modern farmers would consider rainfall, soil composition, fertilizer formulation, phytophagous insect populations, and the range of air and soil temperature to be relevant environmental variables to consider when choosing the type of crop to plant, but would exclude zodiacal and lunar phases from consideration, although these factors are part of the total environment of the crop.

The agricultural example indicates that the components of the environment of the referent that are considered relevant are a function of time and place. In the recent past lunar and stellar components of the agricultural system's environment would have been considered of most importance by almost all farmers. Indeed, in some parts of the world this is still the case. Even in scientific cultures it is possible to find some farmers who "plant by the 'signs'."[1]

Just as the appropriate referent depends on the intent and interest of the user, the components of the environment of the entity that are considered relevant may differ between users, or for the same user at various times. Both an artist and a public health official may focus on an old house. For the artist, the relevant variables will be the position and amount of light striking the house, the trees and other plants in the neighbourhood, and the other background structures; the public health official, on the other hand, would be more interested in the condition of the drainage from the house, the presence or absence of rats or other vermin in the structure, and the possibility that floods will inundate the building.

The nature, amount, and arrangement (or state) of components of the environment of the entity being considered have been treated as relevant variables in many of the examples used so far in this chapter. All three aspects need to be considered when the relevance of any component of the environment of the chosen entity is being considered exhaustively. If the state of the surroundings is neglected, for example, there is a danger of failing to discriminate between two disparate conditions.

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[1] See Eliot Wigginton, ed., The Foxfire Book (New York: Doubleday, Anchor Books, 1972), p. 212 ff. for examples of farmers who swear by these techniques.

This confusion can lead to failure to respond in appropriate ways. The following examples illustrate this point; the first is contrived, but the second is a real-world situation.

Example 1.

Consider the total environment of an individual human at one particular instant. In the first case there is a bullet 2 meter due north of him and 1.5 meter above the level plane upon which he is standing. The bullet is accelerating under gravity. There is an open space between the bullet and the person.

In the second case the bullet is in the same relative position but has a horizontal velocity of 400 $m.sec^{-1}$ south. All other conditions are the same.

The outcome of these two cases, which differ only in the state of one component of the environment of the individual, is clearly different.

Example 2.

Consider the total environment of an individual at one particular instant. In the first case he is in an atmosphere contaminated with solid particles with a uniform size of 1.0×10^{-6}m.

In the second case the total concentration in $g.m^{-3}$ of particles is the same, but they have a uniform diameter of 0.5×10^{-6}m.

Lung damage is less likely to occur in the second case since particles of that diameter are least likely to be deposited in the respiratory system. Even the fourfold increase in the number of particles is insufficient to compensate for the decreased chance of deposition of each individual particle.[2] This result indicates the danger of merely measuring particulate matter in tons/year fallout, and using these data to compare the air quality of different communities. Two communities with the same overall concentration of solid matter in the air will not necassarily be equally susceptible to public health problems from this source.

Similar examples could be provided to illustrate the importance of considering the amount, usually in terms of the concentration, of a particular component of the environment of any referent. The clearest examples are physiological, where the entity being considered is an individual organism and the component of the environment being examined is a metal ion. Copper is essential for the adequate functioning of enzyme systems, but above the physiological concentration it becomes toxic. It is therefore inappropriate to evaluate the food component of the environment of an individual solely on the basis of qualitative analyses which merely indicate the presence or absence of this metal; failure to consider concentration could lead to toxicity or enzyme deficiency.

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[2] U.S., Department of Health, Education, and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, National Air Pollution Control Administration, Air Quality Criteria for Particulate Matter, National Air Pollution Control Administration Publication AP-49, 1969, p. 119 and Fig. 9-3.

Two general points remain to be discussed before possible criteria for determining relevant components are examined. The first concerns the status of products of the entity being considered; the second, somewhat related, concerns the status of non-physical factors such as "concepts" and "cultural principles". The first point can be discussed in terms of non-human examples, but the second requires the referent to be human.

It is clear that structures erected by an organism from components of its environment remain part of its environment; all that has changed is the arrangement or state of those components. The nests of birds are good examples: twigs, hair and/or herbs are arranged to produce a structure which is separate from the bird, and always remains separate, even though it is essential for the bird to reproduce. The same argument must hold in the case of the "edible birds nest" of Chinese cuisine, even though it is produced entirely by salivary secretion of swifts. Extending this position to other less clear-cut cases enables us to see that even where the secreted product is a much more continual requirement for survival than a swift's nest, the secretions become part of the environment of the organism. Coral polyps which cannot survive without their external, secreted, supporting concretions are an example. Yet the calcareous structures are in no sense part of the polyp. Of course, for some purposes, the referent may be the coral reef (secretion plus polyp).

Products that do not serve a useful function are, likewise, part of the environment of the entity that produced them. Human metabolic wastes, cast snake skins, lava flows from a volcanic vent, and oceanic barrier dunes are all products which, once produced, are of no advantage to the producer, but which are part of the producer's environment.

The status of "ideas" or "concepts" as components of the environment of humans is not so readily established. It is not clear whether one can legitimately speak of the existence of concepts, and, if they do not exist, the question then arises whether one can have metaphysical components of the environment. Idea is not being used in the Berkelean manner to refer to anything which is immediately known, such as sense-data. Nor is it being used in the sense of "mental act of apprehending" that Russel distinguishes in his discussion of idealism in The Problems of Philosophy.[3] It is used here in the sense of the "idea of capitalism," the "idea of democracy," the "idea of a unicorn," and even the "idea of Henry VIII" or the "idea of my (unborn) great-grandson." Thus we are speaking of concepts, of hypothetical notions, concerning something or someone which may not now exist, and which may never exist in the physical sense.

A complete analysis of this problem requires considerations of the philosophy of idealism, realism and phenomonology. For the purpose of this work, however, it is not necessary to conduct such a complete analysis. We are interested in establishing some features of environment that will guide an analysis of disparate discussions of 'environment' and if we can show that concepts per se are not relevant parts of the environment, even if they exist, we are not losing any important assistance in our task.

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[3] Bertrand Russell, The Problems of Philosophy (Oxford: Oxford University Press, 1912; Oxford University Press Paperback edition, 1959), pp. 37-45.

To be a relevant part of the environment of a human individual whose welfare is being considered, a concept per se must have the potential for affecting him, say Tom, in some way. It is easy to see that Tom can interact with cultural artifacts--paintings, literature, music, plays, films, newspapers, and the like--and that exposure to the symbols of these artifacts can produce profound changes in him. Basic "ideas" that permeate a culture are transmitted in this way, as well as by stimuli received from adults' speech, dance, and everyday activities. In general, one can only influence another by words, spoken or written, or by non-verbal behavior, directly or via artifacts. (This view need not imply Skinnerian behaviorism, for possible internal events in learning are not involved. The only claim is that behavior of some sort is needed to influence another.)

Even if there is a possibility of "extra-sensory perception" of concepts, the preceding still holds. Psychic researchers are searching for as yet unknown mechanisms that are presumed to have a physical, as opposed to metaphysical, basis.[4] If identified, these would be other physical manifestations that can influence individuals, and concepts per se would not be a relevant part of a person's environment.

These arguments have not considered the possible influence of concepts on the individual that forms them. We have shown that

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[4] E. Douglas Dean, Science 170:1237-1238, 1970.

Tom's concepts cannot be relevant components for Harry, but we have not considered the possibility that Tom's concepts may be a relevant component of his own environment. We need not consider the physical manifestations produced by Tom as a result of an idea or concept that he develops, for his writings, paintings, or other artifacts have the same status for him as they do for Harry, and are therefore clear candidates for consideration as relevant portions of his environment.

If to say that "Tom forms a concept" is equivalent to saying that "Tom's central nervous system has a particular configuration of nervous connections, and (perhaps) particular patterns of ribonucleic acid accumulations" then the "idea" or "concept" is part of the entity 'Tom' and cannot be considered part of his environment. If, however, the idea or concept is claimed to exist in some manner independent of Tom's nervous system, and to be external to him, then it may be part of his environment that could be relevant.

However, it seems impossible to design any experiment that will distinguish between the effect of an independently existing concept that Tom previously developed, and Tom's memory of that concept. Thus, in practice, Tom's concepts *per se* need not be considered part of Tom's environment.

Empirical Tests for Relevance? The discussion in this section has implied that unless a component of the environment of a particular entity has a potential effect related to the purpose of considering the environment, it cannot be considered a relevant part of its environment. Thus, modern farmers do not consider the planets and the moon relevant parts of the environment of their crops, because they do not consider that the phases and astronomical positions of these bodies can influence the growth of their plants. It would seem a simple matter to settle the disagreement between advocates of "planting by the signs" and those who feel that such factors are unlikely to have an effect. All that is needed is a well controlled experiment. If there are no differences in yield, then these variables are not actually relevant.

But consider the case of the artist and the public health official mentioned earlier. There is no experiment that can decide which of these two people is considering the appropriate components of the environment of the old house. The two people are interested in different aspects of the entity, so the components of the environment that they are considering will be different. However, once the purpose is known, an empirical test can provide evidence that a component *is* relevant for that *particular* purpose. The presence of rats would be shown to be a relevant component for the public health officer if there is evidence that their presence is a menace to health. Note that the rats do not have to be shown to be dangerous in this particular case; just dangerous in similar cases. Similarly, the banking of a curve does not have to be shown to be related to the safety of a particular stretch of road: the generalization from past equivalent cases is sufficient to provide evidence that it is a relevant variable in the environment of the drivers who will use the road.

The determination of relevance is, therefore, a two-step process. First, what is the purpose of considering the environment of the entity? Second, does the component under consideration have an effect related to the purpose? It is only the second of these steps that has an empirical answer, and in which experiment or an appeal to observation can help resolve disputes about what is relevant and what is of no interest. Note that the second question has a qualification: "related to the purpose." This proviso is necessary to restrict appeal to empirical evidence to those cases where all parties to the dispute agree on the purpose. The proviso ensures that the first question is posed and answered before an attempt is made to settle any dispute by empirical means.

There can be no clear answer to a question of the first type, which is a question of values. There is no logical method of reaching agreement on the purpose of considering the environment of a particular entity: both Tom and Harry may be considering Mary's environment and the way it might be changed to achieve a particular purpose. Tom may be interested in seduction, and would consider relevant a different set of components than those that would be manipulated by Harry if he was coaching her for an operatic audition.

There are some cases where the purpose of considering the environment of an entity does not involve any direct effect on the entity. It is not uncommon for "environment" and "environmental studies" to be used to refer to all those parts of the Universe other than the human components, but with no intent that there be any study of how these parts affect humans. In these cases the environment is of interest in and of itself. For example, the study of the feeding patterns of the Red-eyed Vireo undertaken in the Chesapeake Bay Center for Environmental Studies has no direct reference to humans, except that it satisfies intellectual curiosity.[5] This is a legitimate use of "environment" which results in different parts of the environment of the human being relevant than would occur in any cases that directly involved *Homo sapiens*. These cases where there need be no interaction between the environment and the entity are identified by asking the purpose of studying the environment. The criterion of *effect related to the purpose* still holds, although it need not be an effect *on the entity* whose environment is being studied.

Summary

The general discussion of 'environment' in this chapter has established the following points:

1. the choice of entity to be separated from the rest of the Universe as the referent for 'environment' is a function of the purpose of the user;
2. the choice of entity is a value choice, and no empirical test can decide which of a number of possible entities is the most appropriate;
3. not all components of the environment are equally relevant;
4. the relevance of any particular component is a function of the purpose of considering the environment;

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[5] Penelope Williamson, *Ecological Monographs* 41:129-152, 1971.

5. relevance can be determined empirically if the purpose of the investigation of the environment is known; and
6. to be relevant, an environmental component must have a potential for an effect related to the purpose being discussed.

These considerations lead to the following questions which need to be asked in evaluating discussions of 'the environment':

> What is the entity that is the referent of 'the environment'?
>
> What is the purpose of considering the environment of this entity?

To determine the relevance of any particular component of the environment of the chosen entity an affirmative answer is needed to the question "Does the component have an effect related to the purpose of considering the environment?" In answering this question it is necessary to take cognizance of the nature, amount, and arrangement of the candidate component.

When these questions are used as a basis for discussion it is possible to concentrate on an evaluation of the actual differences between positions. Rather than toss accusations of bad faith to and fro, one can systematically examine the values involved in the choice of entity; recognize the empirical questions; and seek answers to those questions from the literature or by experiment.

CHAPTER III

REFERENT OF THE ENVIRONMENT

We have seen in Chapter II that the total environment of an entity refers to all parts of the Universe external to that entity. Writers who use 'environment' often add an appropriate delimiting qualifier which indicates the portion of the literal environment that is of interest in a specific context. For instance, we understand references to the *acoustical* environment, the *family* environment, the *therapeutic* environment, the *college* environment, the *urban* environment, or the *cultural* environment. But not all authors use these delimiters although they clearly wish to limit discussion to a portion of the literal environment. This omission leads to disagreement concerning the factors that should be included. For example, Tanner argues that too many factors are being included in present discussions. In his view, "such human dilemmas as war and racism, while they *cause* and *may be caused by* environmental problems, are not themselves usefully viewed as such, especially if strictly environmental problems become obscured in the viewing."[1] War-like and racist acts are clearly components of the total universe external to an individual human, so Tanner is *not* refering to the literal environment in his complaint.

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[1] R. Thomas Tanner, *AIBS Education Division News* 1(4):1, 1972.

When governments set up departments of the environment, and establish "Environmental Protection Agencies," they are not dealing with the total environment. Similarly, "environmentalists" and "environmental educators" are not concerned with the literal environment in their activities. This chapter and the next examine the use of 'environment' in this common, unqualified manner.

The term "*the* environment" is used throughout to refer to this common usage, and is a reflection of the language actually used. We find legislators describing their efforts to protect *the* environment, students mobilizing to clean up *the* environment and oil companies advertizing their their concern for *the* environment. The italicized '*the*' is used to distinguish these cases from references to the total or literal environment, and from situations where an added qualifying term allows the intended limits of the subset of the total environment to be deduced.

In this chapter the nature of the referent for *the* environment will be examined, and the implications of alternate choices discussed by reference to the dispute between Ehrlich and Commoner. In the final section the choice of referent for the remainder of the study is made and justified.

Human Referent

In the article "Genetic Heterogeneity Among Founders of Laboratory Populations of Drosophila IV: Scutellar Chaetae in Different Environments" it is clear that the referent for 'environment' is populations of *Drosophila*. But in the case of the unqualified use of "environment" in "International Environmental Problems--A Taxonomy" and "A Program to Coordinate Environmental Research" one has to infer the entity being considered.[2] In these unqualified cases, however, the entity is usually human, particularly in discussions of "environmental education" and protection of "the environment". Even in discussions of the preservation of the Californian Condor or the Golden Marmoset, when the referent appears to be the species that is in danger of extinction, the human referent is often present. For example, the concern over the possible extinction of the Bald Eagle and other birds by environmental contamination[3] is a cryptic concern for the environment of man. If the eagle becomes extinct, the aesthetic satisfaction of seeing one of the eagles, or even knowing that it exists, will not be available to man.

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[2] Sally M. W. Hosgood and P. A. Parsons, Genetica 42:42-52, 1971; Clifford S. Russell and Hans. H. Landsberg, Science 172:1307-1314, 1971; Raymond Bowers et al., American Scientist 59:183-187, 1971.

[3] See Rachel Carson, Silent Spring (Boston, Houghton Mifflin, 1962) for expressions of concern about the apparent decline of the Bald Eagle that "may well make it necessary for us to find a new national emblem," (p. 119). This comment, and the question "Who has decided--who has the right to decide--for the countless legions of people who were not consulted that the supreme value is a world without insects, even though it is a sterile world ungraced by the curving wing of a bird in flight?" (p. 127) are most easily interpreted as concern for the aesthetic environment of humans, and not purely a biocentric concern for the birds in their own right.
William L. Reichel et al., Pesticides Monitoring Journal 3:142-144, 1969, and Bernard M. Mulhern et al., Pesticides Monitoring Journal 4:141-144,1970, supply data indicating that Bald Eagles are being killed by pesticide accumulations, particularly dieldrin.
Examples of a human-centered concern for the preservation of other species of animals can be found in Robert T. Francoeur, Bulletin of Atomic Scientists 28(2):11-14, 1972.

Concern with the extinction of species by environmental alteration can be readily seen in discussions of the loss of genetic potential by the tendency to use small numbers of grain monocultures in most regions of the world.[4] Here the concern is clearly with the environment of humans. Chances of increasing world food supply by breeding disease resistant crops may be jeopardized unless steps are taken to preserve existing genetic potential in domestic and wild species. "Even if a species does not become completely extinct, a great reduction in its global population will serve to eliminate much of its genetic variation, and, thus, much of its value as a natural resource."[5]

Some people claim that use of a lake as the entity whose environment is being considered in discussions of environmental deterioration is not an argument reflected from concerns of man. For instance, at a conference concerned with environmental problems the following position was put forward as an example of the attitudes of some "environmentalists." Lake Superior is in a relatively pristine condition, unpolluted, and, particularly in the center, rarely intruded upon even by ore carriers, grain boats or pleasure craft. This condition should be preserved, basically because the lake has a right not to be disturbed. Therefore the environment of the lake should be carefully regulated to prevent the introduction of sewage, agricultural runoff, and pesticides, for example. Most participants in the conference, however, believed that this example was really a case where reflected human values were involved. For example, it is a loss to the environment of humans if the last pristine lake disappears for it will decrease the total experience available to man. An alternative argument is that we should preserve the lake in its present condition because any unanalyzed large scale change is likely to make us worse off--if something can go wrong, it will.[6]

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[4] William C. Paddock, BioScience 20:897-902, 1970. p. 899-900.

[5] Institute of Ecology, Man in the Living Environment, (Madison, University of Wisconsin Press, 1972), p. 137.

Individual or Species?

Although the referent is generally, directly or indirectly, human in discussions of the environment, it is not clear whether the entity is an individual or an aggregate of humans. The two main candidates are 'the set *Homo sapiens*' and 'an individual human'. Cases where the entity is 'the human population of the United States' or 'the human population of the political unit Y' also occur, although less frequently than the extremes of 'the species' or 'the individual'.

The choice of entity can lead to profound disagreements between writers concerned with the environment. This is most readily seen by concentrating on one particular debate, that between the positions represented by Paul Ehrlich and Barry Commoner. The position reflected by the writings of Garrett Hardin is also considered in the analysis. Although these writers choose different entities, these differences should not be interpreted as the sole or major source of their disagreements. An analysis of this type cannot test hypotheses concerning the psychological origins of conflict. It can indicate the nature of differences between positions. Armed with this knowledge, the reader is in a better position to evaluate the arguments of the proponents of different positions.

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[6] Unpublished transcript of proceedings of the conference "Environmental Problems and Education," Lake Hope, Ohio, May, 1972.

The controversy between the Ehrlich, Hardin, and Commoner viewpoints is a useful case to examine within the context of this study, which is primarily concerned with the preparation of environmental education curricula: the works of these writers have been used in curriculum development and appear in the educational literature. Ehrlich's book, The Population Bomb, has been set as reading in some courses, e.g., "The Literature of Ecology,"[7] one of the modules of the Dade County Quinmester Program; Commoner has written in educational journals advocating his particular viewpoint;[8] and Hardin is cited in books addressed to educators.[9]

Ehrlich. Ehrlich's emphasis on the species as the entity to be considered can be readily seen in The Population Bomb. The basic thesis of this work is that nothing can save us "unless we can achieve control over the size of the human population . . . [for] mankind will breed itself into oblivion."[10] A further example of the emphasis on the species rather than the individual can be seen in the section "Family Planning and Other Failures"[11] from which the following argument is paraphrased:

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[7] Gloria Douglass and Joyce Annunziata, Authorized Course of Instruction for the Quinmester Program; Language Arts: The Literature of Ecology, (Miami, Florida: Dade County Public Schools, 1971).

[8] Barry Commoner, The Science Teacher 39(5):18-24,1972.

[9] Hardin's paper "The Tragedy of the Commons" is reprinted in J. W. George Ivany (ed.), Environment: Readings for Teachers (Reading, Addison-Wesley, 1972), pp. 105-119.

1. People in both "overdeveloped" and "underdeveloped" countries desire an average of more than 2.5 children per completed family.[12]
2. Therefore, even if all women had exactly the number of children that they desired, the population of the world would continue to increase.
3. Thus, although the ability to decide the number and spacing of children is important for individual health and welfare, family planning will result in demographic catastrophe.[13]
4. Therefore, family planning, which is not equivalent to population planning, is an inadequate policy measure.

The prime focus on the chances of species survival manifested in the discussions of "demographic catastrophe" is maintained when changes in the composition of the air and water, the use of resources, and the production of food, are being considered.[14] Even in sections of The Population Bomb where concern is being expressed for the individual human the ultimate interest is in the preservation of the species. Discussions of the inescapable miseries faced by individuals who are members of large families in poor regions of the world; the destruction of recreational potential by pesticide contamination of streams; and the decreased enjoyment of life caused by living in contaminated air with its attendant health costs, e.g., from emphysema and cancer, appear to be examples of Ehrlich's concern for individual welfare and happiness.[15] This interpretation is apparently reinforced by the discussion of the desirability of having abortion available as a method of last resort for population planning: "above all, biologists must take the side of the hungry billions of *living* human beings today and tomorrow, not the side of *potential* human beings."[16]

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[10] Paul R. Ehrlich, The Population Bomb, 2 ed. (New York: Ballantine, 1971), p. xii.

[11] Ibid., p. 78 ff.

[12] The accuracy of the "facts" used in Ehrlich's arguments is not important at this point. The entity being considered does not depend on the accuracy of the facts concerning the parameters of that entity, its components, or its environment.

[13] Throughout The Population Bomb probable eventual extinction of the species is considered the result of the "demographic catastrophe" that results from an excess of births over death in the population of the world; e.g., p. 44.

However, these concerns are expressed as examples of symptoms of the "disease" of overpopulation, which if unchecked will lead to the destruction of the species. If the cause of these symptoms is eliminated by achieving zero population growth, *then* the concerns for the individual can be emphasized. Many of the so-called inalienable rights in the book are statements of the individual entitlements that will follow from the preservation of the species, e.g., "the right to have great-grandchildren," or which, if attained, will lead to a greater chance of species survival, e.g., "the right to be free of thermo-nuclear war."[17]

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[14] *Population Bomb*, p. 35, 40, 144, 18-25.

[15] Ibid., p. 22, 141, 142. [16] Ibid., p. 139.

One must not be misled into interpreting Ehrlich's emphasis on the importance of individual behavior and individual choice in achieving population stability[18] as evidence of his prime concern for the individual. The basic reason for advocating smaller family size remains the enhancement of the chances of species continuity. There is no inconsistency in this position: just as the physician is primarily concerned with the health of the individual human, and concentrates on treating, for instance, diseased liver cells so that the patient can be restored to health, Ehrlich is advocating changing individual desires as a means of increasing the "health" (i.e., chance of survival) of Homo sapiens.

The forgoing summary should not be construed to imply that no expression of concern for the individual's feelings or rights is made in The Population Bomb. The author clearly abhors the possibility of the "death solution" to population growth, for this method of achieving population stability would result in early death from famine, war, or pestilence. He expects much less personal anguish if a desire for a smaller completed family size leads to a balance between birth and death rates; that is, if a "birth solution" is achieved. The only proscriptions on individual "rights" advocated or implied in The Population Bomb are those which, if exercised, would lead to a decreased chance of species survival. For example, the claim that one has a right to have as many children as one desires is denied.[19]

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[17] Ibid., p. 171. Both quoted "rights" are from a list offered as counter-argument to a claim that there is an "'inalienable right' to have as many children as one wants." They are, therefore, somewhat rhetorical, but they are evidence of Ehrlich's general concern with the species as a whole.

[18] Ibid., "The only real hope in this crisis lies in the grass-roots activities of individuals," (p. 159); "If we take the proper steps in education, legislation, and research, we should be able in a generation to have a population thoroughly enjoying its sexual activity, while raising physically and mentally healthier children, but in smaller numbers," (p. 135); coercive measures are almost certain to be impossible, but incentives to encourage individuals to decide to have less children are practicable, p. 131-2.

Commoner. The individual human is the referent for Commoner's 'environment'. But just as Ehrlich's prime concern for the continuity of the species does not mean that he denies individual rights, (provided that the species is not threatened by the exercise of those rights), Commoner's position expressed in The Closing Circle is compatible with a concern for the survival of Homo sapiens. He is certainly concerned with the long-term survival of the species, but not at the cost of the loss of human dignity or social justice. For example, his judgement is that, in industrialized countries, environmental degradation may be sufficiently serious that a continuation of present trends will "destroy the capability of the environment to support a reasonably civilized human society."[20] Although the species may not become extinct following the collapse of civilization, the survivors would exist in a "kind of neo-barbarism."[21]

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[19] Ibid., p. 171. (see note 15).

[20] Barry Commoner, The Closing Circle: Nature, Man and Technology, (New York: Knopf, 1972) p. 217-18.

He expresses similar feelings of revulsion at the implications of Hardin's editorial advocating national self-interest by "fortunate minorities." These minorities, by implication including the United States, must, Hardin insists, defend their territory and avoid a "ruinous breeding race" so that "civilization and dignity" can survive in at least some areas of the earth.[22] This policy, Commoner retorts, "is barbarism. It denies the equal right of all the human inhabitants of the earth to a humane life." Nowhere, he claims, not even in the "civilized" enclaves, which would be reduced to "the moral level of the barbarian," would "anything that we seek to preserve--the dignity and humaneness of man, the grace of civilization--survive."[23]

The environmental problems that Commoner uses to illustrate his argument emphasize social, including health, costs of environmental degradation: lung damage from nitrogen oxides in automobile exhausts; infant methemoglobinemia from high levels of nitrate ions in drinking water containing run-off from heavily fertilized farm land; recreational loss from closed beaches where coliform counts are high; discriminatory exposure of the poor to the greater burden of health hazards and aesthetic deterioration in the "dirt, smog, carbon monoxide, lead and noise" of the city; and possible exposure to new diseases, for which no immunity exists, when surface waters contain sufficient organic matter to allow many soil organisms to grow to a high concentration.[24]

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[21] Ibid., p. 218.

[22] Garrett Hardin, Science 172:1297, 1971.

[23] Closing Circle, p. 297.

In addition to using effects of environmental deterioration on individuals in present society to demonstrate the need for reform, Commoner believes that human social actions, or inactions, have caused the environmental crisis which is "the result of the social mismanagement of the world's resources."[25] Only through social actions that result in the denial of the "luxury of tolerating poverty, racial discrimination and war" can the environmental crisis be solved, allowing men to live in a humane condition.[26]

Commoner v. Ehrlich. The use of different entities as the unit whose environment concerns them accounts for some of the disagreement between these authors that is revealed in their dialogue in The Bulletin of the Atomic Scientists.[27] Examples of the use of different entities in the dialogue are given below.

Commoner's use of an entity smaller than the species is evident in the following claims:

1. The environmental impact incurred during foreign production of goods imported into the United States is irrelevant,

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[24] Ibid., p. 72, 82, 94, 208, 222. [25] Ibid., p. 299.

[26] Ibid., p. 296.

[27] Paul R. Ehrlich and John P. Holdren, Bulletin of the Atomic Scientists, 28(5):16 et seq., 1972; Barry Commoner, Ibid., 17 et seq., 1972; John P. Holdren and Paul R. Ehrlich, Ibid., 28(6):42-45, 1972.

because "what is at issue . . . is the explanation of the environmental impact in the United States,"[28]

2. United States citizens ought to weigh data concerning environmental paramaters against their own belief systems to determine the appropriate individual course of action.[29]

Ehrlich, writing with his colleague Holdren, on the other hand, refers to "man's ecological transformation of the planet,"[30] and asks "How can Commoner try to consider the United States in isolation after writing 'Everything is connected to everything else'?"[31] They also write that population control and stabilized consumption "offer mankind's only hope of averting unprecedented misery. It is better to tell the rich that they will have to share to survive, and to tell those who want large families that the price is mortgaging their children's future" than to suggest that more popular technological solutions are possible or that the demographic transition will stabilize population sizes.[32] This last quotation could appear to be refering to individuals who may suffer misery, but "unprecedented misery" implies a species referent: one starving individual or family is unlikely to be any more miserable if an unprecedented number of others are also starving or diseased. Ehrlich and Holdren are, predominantly, concerned with the species, not merely individuals in the United States.

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[28] Commoner, Bulletin, 28(5), p. 49. [29] Ibid., p. 55, my italics.

[30] Ehrlich and Holdren, Bulletin, 28(5), p. 18.

[31] Holdren and Ehrlich, Bulletin, 28(6), p. 44.

[32] Ehrlich and Holdren, Bulletin, 28(5), p. 27.

Perhaps Ehrlich and Commoner use different entities when considering 'environment' because they have different opinions concerning the causes of the deterioration of land, air, and water quality.[33] Commoner attributes the symptoms to social action that supported, or at least permitted, technological changes detrimental to the continued ability of the ecosystem to maintain closed ecological cycles. Ehrlich tends to place the "blame" on a biological tendency to have families too large to maintain a stable population size. Indeed, the dialogue in the Bulletin has the appearance of an attempt to decide empirically between these causes.

However, even if the initial interpretation of the causes of the environmental problems lead to different entities being considered in subsequent work, it is most unlikely that there can be an empirical resolution of their conflict. The concentration on different entities leads to different sets of evidence being considered. For example, Ehrlich looks at evidence concerning the effects of diminishing *per capita* food supply on the chances of species survival; Commoner examines the evidence relating to the origin of the nitrate ions in the drinking water of infants with methemoglobinemia; Ehrlich concentrates on the impact on the species' resources of increasing population size, while Commoner examines the deterioration of the quality of life resulting from resource over-exploitation with its attendant technological by-products.

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[33] This is a speculative hypothesis. The psychological origin of the authors' beliefs cannot be accurately determined by an analysis of their writings.

As a feature writer for Science points out, in the context of a slightly different disagreement between these authors, there can be no agreement on the rules when one is playing poker and the opponent is playing bridge.[34]

Other Authors. In many cases other authors writing on 'environment' appear to be discussing topics that have no relationship to each other. It is easy to see that the entity used has important consequences when authors are concerned with the same components of the environment; Ehrlich and Commoner, for example, are both concerned with the decreasing food supply, deterioration of the air and water, and the depletion of resources. But when there are differences in the environmental variables being examined, it is not as easy to demonstrate that a different choice of entity could lead to a difference between the consequences of following different authors' environmental prescriptions.

Architects and planners, for instance, are, by the nature of their profession, concerned with the well-being of their clients. They are, therefore, qua architects and planners, extremely unlikely to be concerned with the long-term future of the species. They are concerned with the individual, and the response that he makes to the artifacts constructed by man.[35] Similarly, some sociologists and most psychologists are professionally concerned with the individual, or, less frequently, a group (as distinct from an individual within a group).[36]

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[34] Constance Holden, Science 177:245-247, 1972.

[35] See, for some specific examples of architects' concern for individual humans, Gordon Stephenson, in Man and His Environment; Octagon Lectures 1969, ed. R. T. Appleyard (Nedlands: University of Western Australia Press, 1970), pp. 97-127; Donald Appleyard and Mark Lintell, Journal of the American Institute of Planners 38:84-101, 1972; and Christopher Alexander, in Environment for Man: The Next Fifty Years, ed. William R. Ewald, Jr. (Bloomington, Indiana

Ecologists tend to write of the environment of a species, examining its place in the ecosystem. Individuals are treated as components of the entity which interacts with the environment, much as a physiologist considers cells as components of the organism in which he is interested. When writing in their professional role, then, it is not surprising to find ecologists concerned with the human species. Marston Bates, for example, considers "the future of our species" in his introductory essay in the report of the National Academy of Sciences/National Research Council.[37]

The species is the entity considered by the Club of Rome project based on a simulation model of global factors thought likely to influence the fate of the human species, and in the report of the Study of Critical Environmental Problems (SCEP) sponsored by the

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University Press, 1967), pp. 60-102. The twelve other architects and town or city planners who prepared papers for Environment for Man and the other two volumes edited by Ewald /_ Environment and Policy: The Next Fifty Years (Bloomington: Indiana University Press, 1968) and Environment and Change: The Next Fifty Years (Bloomington: Indiana University Press, 1968)_/ all use the individual as their referent, usually explicitly.

[36] See, for a specific example of a sociological focus, William L. Yancey, in Environment and the Social Sciences: Perspectives and Applications, ed. Joachim F. Wohlwill and Daniel H. Carson (Washington: American Psychological Association, 1972), pp. 126-136. Wohlwill and Carson, in their editorial epilogue to this collection, identify four areas not represented in their collection where "environmental psychology" can make a contribution to knowledge. Each of these areas has the individual as the appropriate entity.

[37] Marston Bates, in Resources and Man, Committee on Resources and Man (San Franscisco: Freeman, 1969), p. 29.

Massachusetts Institute of Technology.[38] Both these groups are concerned with global factors, the first because of the possibility that these factors have "implications so threatening that their resolution should take precedence over local, short-term concerns;"[39] and the second because "no organization is charged with the responsibility for determining the status of the total global environment and alerting man to dangers that may result from his practices."[40] Almost inevitably, therefore, these studies were not primarily concerned with the consequences of actions for each individual human. The SCEP report refers, for example, to the "danger that we may curtail an environmental service without being able to carry the loss or /that/ we may irreversibly lose a service that we cannot live comfortably without,"[41] and defines "harmful effects" as those "effects that are harmful to man, or to animals, plants, or inanimate objects or conditions that are important to man."[42] The context of the report supports the contention that "man" is being used in the generic sense in this definition.

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[38] Jay W. Forrester, World Dynamics (Cambridge, Mass.: Wright-Allen Press, 1971); Donnella H. Meadows et al., The Limits to Growth (New York: Universe Books, 1972); Man's Impact on the Global Environment: Assessments and Recomendations for Action, Report of the Study of Critical Environmental Problems (Cambridge: Massachusetts Institute of Technology Press, 1970).

[39] Limits to Growth, p. 20.

[40] Impact on Global Environment, p. 5. [41] Ibid., p. 126.

[42] Ibid., p. 224.

"Official" Positions. In the United States, interpretations of 'the environment' are incorporated in Federal legislation and executive orders. Other legislative units also have statutes that refer to environmental protection, but the Federal position is examined in this section since much of the environmentally significant action at State and Local levels is either financed by Federal grants, or is enacted under pressure from Federal authorities.[43] The most general and wide-ranging Federal legislation in the environmental area is the "National Environmental Policy Act of 1969."[44] This act requires Federal agencies to consult with other Federal agencies and to prepare an environmental impact statement for every "recommendation or report or proposal for legislation and other major Federal actions significantly affecting the quality of the human environment."[45]

The human entity whose environment is being considered is not explicitly identified, and, as can be seen in the following excerpts, it is possible to interpret the references to "man" in both the species and the individual sense in different sections of the Act:

> (a) The Congress . . . declares that it is the continuing policy of the Federal Government, in cooperation with State and Local governments, and other concerned . . . organizations, to use all practicable means and measures . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future

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[43] For example, States must establish implementation plans for air pollution control, subject to Federal approval, or submit to the imposition of a Federally promulgated plan. See U.S., Council on Environmental Quality, Environmental Quality: The Second Annual Report (Washington, D. C.: Government Printing Office, 1971), p. 8.

[44] U. S., Public Law 91-190. [45] Ibid., Section 102(C).

> generations of Americans.
>
> (b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to . . . improve and coordinate Federal plans, functions, programs and resources to the end that the Nation may--
>
> (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
>
> (2) assure for all Americans safe, healthful, productive, and esthetically pleasing surroundings;
>
> (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable or unintended consequences;
>
> (4) preserve important historical, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
>
> (5) achieve a balance between population and resource use which will permit high standards of living and a wide share of life's amenities; and
>
> (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.
>
> (c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.[46]

The Act has been quoted extensively above to illustrate the potential ambiguity of the referent. In section (c) the referent is clearly the individual American, and the same referent is apparently being used in (b) (2), (b) (4), and (b) (5). However, in parts (a), (b) (1), and (b) (3) it is possible to argue that an entity larger than the individual is being used. In both (a) and (b) (1) the reference to future generations suggests that it may be the species viewpoint that is being used, although it is also possible to interpret these statements in terms of individuals who will exist in the future. Similarly, the reference to "health and safety" in (b) (3) is most easily interpreted as concern for the individual, but "other undesirable and unintended consequences" could intend either the 'individual' or the 'population of the U.S.' as the referent. Despite this ambiguity of referent, the language of the Act is most consistently interpreted as concern for the environment of the individual: some parts can only be interpreted in this manner, others could be.

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[46] Ibid., Section 101.

Similar focus on the individual is reflected in the President's message on the environment of February 8, 1971. In that message, the topics highlighted (pollution control--sulfur oxides, leaded gasolines, water purity, municipal waste, oil spills, and pesticides; ocean dumping; noise; land use, including preservation of open space and parks; preservation and restoration of historic sites) are concerned almost entirely with the direct or indirect effects of environmental deterioration on the possibility of a "better life" for individual Americans and other nationals. Toward the latter end, proposals were included for international environmental cooperation.[47] In his 1971 report to the Congress on U.S. Foreign policy, the President made reference to the necessity to work towards international agreements on environmental control. Although he spoke of "our shared and transcendent interest in the livability of our common home, the earth" the examples of environmental concern contained in that message are those that refer to the individual humans in different parts of the world.[48]

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[47] U.S., President's Message on the Environment, February 8, 1971. Reproduced in Environmental Quality: The Second Annual Report, pp. 284-305.

[48] U.S., President's report to the Congress on United States foreign policy for the 1970's, excerpted in Environmental Quality: The Second Annual Report, pp. 333-335. p. 334.

The Department of State report prepared for the United Nations Conference on the Human Environment[49] is consistent with the emphasis on the individual in the official treatment of 'environment' in the United States. Despite the statement that "the quality of our environment--indeed of life itself--is land dependent. No other segment of human environment deserves more grave consideration than this fragile crust of soil from which we derive our sustenance"[50] the examples given in the body of the report are concerned with the development and maintenance of environmental conditions that will "maintain a life of dignity and social justice."[51] The report considers the impact of urbanization on "social degradation and alienation" as well as on the physical well being of residents;[52] of pollution on health, economic well-being and aesthetic satisfaction;[53] and of the use of natural resources "so that economic growth and social progress can continue without jeopardizing the health, safety, and well-being of people or endangering the Nation's security."[54]

Reports of other countries to the U.N. Conference on the Human Environment also tend to consider the environment of the individual. For example, Gabon reports that its major environmental problem is one of diseases of environmental origin--malaria, trypanosomiasis, polyparasitosis; Indonesia discusses the public hazards of water pollution and the decrease in water supply due to denudation of the watersheds, which has also contributed to soil erosion and flooding; Peru is concerned with health aspects of air pollution and sewage, as well as with the effects of environmental degradation on food supply--sulfur dioxide in the air harms crops; and Guatemala emphasises public health problems resulting from the lack of a sanitary environment.[55]

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[49] U.S. Department of State , Bureau of International Scientific and Technological Affairs, U.S. National Report on the Human Environment, 1971.

[50] Ibid., p. 2. [51] Ibid.

[52] Ibid., pp. 5-6; quotation from p. 6. [53] Ibid., pp. 18-27.

[54] Ibid., pp. 7-17; quotation from p. 7.

Values and the Choice of Referent

In Chapter II it was shown that the choice of entity for any discussion of 'environment' is arbitrary, requiring a value judgement that depends upon the purpose of the discussion. The variations in the entity whose environment is being considered in the small number of cases used as examples in this section on "the environment" is in agreement with that result. The entity used may depend on the professional field of the writer, or upon the nature and scope of the problem that interests him. However, as the Ehrlich and Commoner disagreement indicates, there may still be differences between authors with basically similar professional backgrounds and concerned with similar problems.

Thus, except in those cases such as psychiatry,and global meteorology, where the nature of the interest dictates the choice of entity, a decision based on values must be made where there is a possibility of incompatibility between the consequences of choosing different entities.

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[55] These examples are drawn from The Human Environment. Vol. II: Summaries of National Reports Submitted in Preparation for the United Nations Conference on the Human Environment. Environment Series 201 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 1972), pp. 26, 40-41, 72-73, and 31.

If one believes that the dignity and well-being of existing humans is of overriding importance, one may, in the end, come to feel that the effort to ensure perpetuation of the species imposes too great a price in loss of freedom of individual action. Perhaps, if it is impossible to ensure continued survival without imposing massive restrictions on the options available to the individual, many will say "count me out."

If it becomes impossible to enforce the necessary renunciation (i.e., the sacrifice of some present benefits by those alive today to ensure a greater chance of survival of as-yet-unborn generations), there is little point in some individuals forgoing activities that are beneficial to them but detrimental to their descendants. Unless "selfish" individuals do not tend to be children of persons with similar traits, (i.e., unless "selfishness" is randomly distributed in the individuals of each generation), those who limit their family size and resource consumption will become less frequent in each generation. This replacement will occur whatever the initial proportion of selfless individuals in the population, and whether the trait is learned or genetically inherited.

The curriculum developer needs to be aware that if his major emphasis is on the quality of the environment of the individual he may be espousing a system of values that could favor species extinction. A thorough-going individualism may discourage the establishment of policies that require sacrifice of some personal satisfactions to decrease the probability of a massive future catastrophe, say three generations hence. For example, a commitment to supply every individual with the capability of having an immediate environment completely free from health hazards from atmospheric and food contaminants should be a technologically feasible goal. One can imagine the creation of complete domed cities where the temperature range can be accurately controlled, air purified of dust and gaseous contaminants and humidified to the appropriate level, and complete separation of pedestrian and vehicular traffic maintained. The energy required to provide a local environment with all physical hazards removed may result in the destruction of the ecosystem's capacity to absorb the inevitable heat disipated. This could lead to massive geothermal change. If this change, or a shortage of available energy, occured, then the system would probably collapse. The resulting massive catastrophe may even lead to the destruction of the species.

Science fiction aside, even less extreme commitments to the individual's environment may even now be creating a trend toward global damage. Global levels of atmospheric carbon dioxide have been increasing at the rate of 0.2% per year since 1958. Although data enabling a reliable projection of this trend are not available, a doubling of the carbon dioxide level might increase mean annual surface temperatures by 2^0C.[56] A change of this magnitude would affect the agricultural productivity of the planet as well as altering mean sea level by melting of ice caps.[57] At least one of the major contributors to carbon dioxide buildup is the burning of fossil fuels, including those used for personal environmental control, directly (e.g., heating via natural gas), or indirectly (electrically operated air conditioners).

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[56] Impact on Global Environment, Part II, Section 1.2.1.

Conversely, an exclusive concern for the future of the species may lead to policies that would result in the decrease of the quality, or even the possibility, of individual life. Taking an extreme example again, it is conceivable that a "species manager" could limit the stresses on the life-support system of the biosphere by forcibly denying selected individuals or, more likely, groups, access to world food supplies, energy resources, or living space. This would be technologically simple, requiring the will to use the available weapons, military or economic, that would result in population crash in the selected regions of the world, either directly or by large scale famine. This sounds callous to those who have a basically individual-oriented value system and believe in the dignity of man, but it is not very different from the proposal to use a "triage" technique, separating the regions of the world into those that can survive without aid, those that can survive if aid is given, and those for whom the available aid is insufficient to bring population and resources into balance.[58] The deliberate neglect of the third category is not greatly different from a policy of deliberate direct action aimed at producing the same result--population crash--at an earlier date. The individual suffering and deprivation that would result from a policy such as this is obvious. Some such unconcern for individuals must result from a consistent application of the the principle of the "rights" of the species, even if not as extreme as in this example. For example, Hardin's implied advocacy of sanctions against large families to achieve population control, either by legal methods, or "informal (nonstatutory) communal mechanisms that possess the repressive force and universality of statutory law,"[59] can be interpreted as lack of concern for one aspect of individual choice and personal freedom.

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[57] An increase of this magnitude in the mean temperature of the earth would result in the northward movement of the appropriate climatic zone for corn production in North America. That is, the land area now devoted to grain production would need to be converted to other uses, and more northern land changed to grain production. The resulting disruption, not only in the U.S. corn belt, but in other agricultural areas, may decrease world food production. This is certainly speculation, but the possibility of famine produced by climatic change is real. Coupled with the loss of arable land from an increase in sea level, this could result in decreased chances of species survival, for mass famine, in addition to causing death from starvation, may facilitate pandemics. The reduction in the world's population may be so great as to make species survival doubtful.

Referent for this Study

The selection of the ultimate entity whose environment is to be considered is a value choice that must be made in terms of the system of beliefs of the curriculum developer, teacher, or the community that they serve. However, the remainder of this work is written from the position that the ultimate concern is with the individual, but that where alternate actions that would each enhance the well-being of all individuals are possible, the action that is least detrimental to the prospects for continued survival of the species is the appropriate choice. That is, I am not prepared to sacrifice the well-being of existing individuals for the possible good of the hypothetical humans of the year 2500. In the very long term Homo sapiens on earth is doomed to extinction: the Sun has a finite life, albeit a very long one. At some time, then, the position that species concern is the appropriate basis for action must become inappropriate. And, as shown below, the short term (say the next century) practical consequences of this "individualist" position are not likely to be very different from a concentration on species planning.

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[58] The triage proposal, based on military medical practice, was proposed by earlier authors and endorsed, "at least as far as food distribution during famine is concerned," by Ehrlich in The Population Bomb, p. 147.

[59] This aspect of Hardin's position is evident in his papers in Science 162: 1243-1248, 1968; Science 172:1297, 1971; and Bulletin of the Atomic Scientists 28(6):37-41, 1972, from which the quotation is taken, p. 39.

This choice should not be taken as a call for the legitimization of anarchy; the maximum concern for the dignity of the individual requires some system of social organization. Nor does the choice entail isolation of concern to the local community or a single nation. It is meant to imply that the dignity of all humans is respected, wherever they reside, and whatever their biological, cultural, or social heritage. This position implies that some individuals will have to give up personal practices that provide benefits only obtainable at the expense of the well-being of others. It will almost certainly be necessary to forgo some existing activities that lead to decreases in the chances of health of other members of the community, in the possibility of others being able to enjoy the aesthetic qualities and cultural activites available in urban areas, and the chances of other people being well-fed. That is, the position implies that social and political practices that provide advantages to some people at the expense of others ought to be eliminated.

Single-minded use of the individual as the referent of 'the environment' is almost certain to mean, in practice, that many of the end results will be similar to those advocated by the writers who consider the species as the entity whose environment is deteriorating. This "individual" position is quite compatible with that of advocates of population planning, for an increased world population inevitably reduces the share of the world's resources available to each individual, both for food and for aesthetic and cultural pursuits.

Planning predicated on this position does not depend upon personal, individual "altruism" for success, for it is possible in principle for a strong social value to pervade government. It may, however, be necessary for a sufficient majority to come to hold a similar view before the forces of law can establish the principle. The major flaw, as with any of the long term schemes advocated by any group of "environmentalists", whatever the entity that they choose to emphasise, is that the end being aimed at is utopian. If the experience of past utopian experiments is any guide it is unlikely that the goals will be soon attained. However, this does not seem a sufficient reason for avoiding an attempt to live in harmony with our individual environment. Given the value system stated, there is no justification for refusing to attempt to counter environmental deterioration, or justifying giving up the battle and hedonistically enjoying what time there may be left to us.

One consequence of choosing the individual human as the entity in environmental education discussions is that it implies that other humans are part of the total environment. Thus interpersonal relations are candidates for consideration as relevant portions of the environment. This possibility is considered in the next chapter.

Caveat. Basing decisions on individual well-being is not a panacea. It is still necessary to weigh situations where there may be conflicts between the rights of individuals, especially when there is no action that will simultaneously ensure equal well-being for all individuals.

For example, a very difficult decision has to be made if a serious infectious disease, for which no cure exists, arises in an area. If uninfected areas impose a strict quarantine, and prevent any travel from the infected area, the possibility of developing a cure in laboratories in the unaffected parts of the world is reduced. The imposition of the strict quarantine would contribute to a diminution of the inhabitants' well-being, particularly if the disease spreads so rapidly that food production and distribution is effectively stopped, for the return of food ships to uncontaminated areas could bring the disease to new areas. What should be done? Refrain from imposing an absolute quarantine in the slim hope that a cure may be found, and risk the spread of the infective agent all over the world? Impose the quarantine in an attempt to preserve the chances of survival of residents of healthy regions, and, in effect, ignore the plight of the victims?

The individual well-being position does not give a simple answer, but it does force a consideration of the options. A species-ethic would lead to the destruction of the infected individuals, in the same way that agricultural officials destroy all pigs that have been, or may have been, exposed to an active case of swinepest. A strict species position would allow no option, and the tendency would be to err on the side of exterminating more people than "necessary," for this would reduce the chances of any infected person surviving.

Although it does not provide a simple formula for action in all cases, the position based on individual concern does keep more options open, and does force each case to be considered on its own merits.

Summary

There is an implicit recognition that the referent of '*the* environment' is human. However, different authors may use a different human entity as the referent; some use the individual, others the population of a political unit, and some use the set *Homo sapiens*. The choice of referent can lead to different recommendations for action, and, if there are unrecognized differences in the entity whose environment is being examined, to futile attempts to resolve disputes by empirical evidence. The dispute between Paul Ehrlich and Barry Commoner is one instance of differences in the human entity used as referent for '*the* environment' leading to psuedo-empirical attempts at conflict resolution.

For the purposes of this study the *individual* human has been chosen as the entity. This choice has been made since at some time in the very distant future the species must become an inappropriate referent, for it cannot survive indefinitely. And, in the short term, the next two hundred years for example, the actions that will lead to the well-being of *all* individuals are likely to contribute to species survival also.

CHAPTER IV

RELEVANT COMPONENTS OF THE ENVIRONMENT

If we were concerned with the total environment of an individual human we could determine the relevance of any particular part of the Universe by applying the test developed in Chapter II. For this work we have chosen to consider the well-being of individuals, so, if any part of the total environment has an effect on the individual that enhances or reduces his chances of health or of aesthetic enjoyment, that part is relevant in environmental investigations. However, as indicated in the introduction to Chapter III, some factors that have effects on individuals are excluded from *the* environment in some contemporary discussions.[1] Therefore this test, although necessary, is not sufficient to distinguish components of *the* environment.

Just as the referent for '*the* environment' is implicitly recognized as human, there is an implicit application of criteria that determine whether something is part of *the* environment of the human. Whenever someone speaks of *the* environment he has determined the components of the total environment that he wishes to include. This determination may not be verbalized, and the user may not have formulated any explicit criteria. In this chapter we will investigate the nature of these criteria by first examining relevant (sense of Chapter II) non-human components of the total environment of an individual that normally count as parts of the environment . The explicit criteria derived from this examination will then be applied to cases where 'other individuals' can be considered as candidates for inclusion in the environment . This will allow us to see whether the same criteria hold if 'other humans' is ever considered part of the environment.

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[1] See the discussion of Tanner's article, p. 37.

Non-Human Components of The Environment

If we can show that the candidate component has a potential effect on human health it has satisfied the criterion of affect. This is so because we are concerned with the well-being of individuals in our assesment of 'environment', and physiological health is one component of human well-being. The importance of the "potential" in the test is most readily seen by considering a non-controversial relevant environmental component. Peroxyacetyl nitrate (PAN) is a relevant component of the environment for individual men, for its presence in the air may cause eye irritation, and, possibly, have other physiological effects.[2] All men need not be affected at every exposure for PAN to be considered relevant for all men. Sensitivity to PAN varies between individuals, and when one person has irritated eyes his companion may exhibit no symptoms. But this result does not mean that PAN is a relevant component of the environment of the first person and not of the second; it is reasonable to consider PAN a potentially relevant component of the environment of any person, even one who has never been exposed to it. There is a finite empirical probability that, when subjected to a particular concentration of the compound in the air, eye irritation will result. Therefore, it is reasonable for a region that has not experienced similar concentrations to those that occur in Los Angeles to monitor air quality, take preventive measures, or warn as-yet-unexposed individuals when concentrations of PAN reach a potentially dangerous level. (PAN has not been extensively investigated, and little is known about physiological effects other than eye irritation and increased respiration rate . Even for these effects data are not extensive. Yet it is normally considered part of the environment.

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[2] U.S., Department of Health, Education and Welfare, Public Health Service, National Air Pollution Control Administration, Air Quality Criteria for Photochemical Oxidants, National Air Pollution Control Administration Publication AP-63, 1970, p. 8-38.

When we examine different situations involving a component of the total environment that affects the health of individuals we can recognize instances when this component is not considered to be part of the environment. Sufficient examples may suggest criteria that are being implicitly applied to determine whether something is part of the environment.

Examples. Carbon monoxide is detrimental to human health. When present in a concentration of 4,000 ppm by volume the gas can cause death in less than one hour. Concentrations of from 1,500 to 2,000 ppm by volume are dangerous if they persist for one hour.[3] Thus carbon monoxide, a component of the Universe external to the individual, can affect his well being. It is therefore a candidate for inclusion in *the* environment. However, when a person in a closed garage intentionally runs his car at idling speed and commits suicide by exposing himself to carbon monoxide, which may constitute 7% of the exhaust gas under these conditions, he is not normally said to have died from an environmental hazard. But a person who becomes ill while working in a poorly ventilated motor vehicle repair shop where a high concentration of the gas has accumulated is described as being affected by a hazard in *the* environment. There is also concern about the level of the compound in the air of cities, where it is considered an environmental hazard.[4] Thus, carbon monoxide is not considered part of *the* environment in the first example, but it is in the second and third.

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[3] Frank A. Patty, in Industrial Hygiene and Toxicology, 2d rev. ed., ed. Frank A. Patty (New York: Wiley, 1963), vol.II, Toxicology, ed. David W. Fassett and Don D. Irish, pp. 928-931.

The numerous similar examples that could be adduced are best considered together in the context of the difference between 'toxicology' and 'environmental toxicology'. "Environmental toxicology" courses are taught at at least one university[5] with the implication that there is a difference in subject matter between "toxicology" and "environmental toxicology." This difference is exemplified by the carbon monoxide case, where the data that enable the lethal dose to be determined are derived from toxicology *per se*; environmental toxicology is concerned with the effects of long-term, perhaps low-level, chronic exposure. Similarly, environmental toxicologists investigate the long-term exposure of miners, typecasters, pewter workers, and paint manufacturers to antimony compounds such as stibine (SbH_3); toxicologists have determined the effects of acute doses of stibine, and investigated the toxicity of antimony compounds used in therapy, for example, potassium antimony tartrate used in the treatment of schistosomiasis.[6]

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[4] Merril Eisenbud, *Science* 170:706-712, 1970; Alfred C. Hexter and John R. Goldsmith, *Science* 172:265-267, 1971; and Merril Eisenbud and Laurel R. Ehrlich, *Science* 176:193-194, 1972. Note that carbon monoxide is not considered to have *global* significance as an environmental hazard: *Man's Impact on the Global Environment: Assessment and Recommendations for Action*, Report of the Study of Critical Environmental Problems (Cambridge: Massachusetts Institute of Technology Press, 1970), p. 55

[5] The Ohio State University, Department of Preventive Medicine.

Toxicologists have been interested in the lethal doses of substances used as food additives; environmental toxicologists in the possible sub-lethal consequences of unavoidable chronic exposure to these compounds in the diet. Toxicologists have traditionally determined lethal doses of compounds acting singly; environmental toxicologists have become increasingly concerned with the effects of simultaneous unavoidable exposure to a number of contaminants in, for example, the atmosphere of cities: for instance, the presence of solid particles enhances lung damage caused by sulfur oxides.[7]

It seems, then, that when a toxicologist speaks of compounds in 'the environment' he is speaking of substances that the individual cannot readily avoid, and that are not deliberately administered to that particular person. Thus, although one cannot avoid being poisoned by a skillful murderer, the substance deliberately administered is not considered part of the environment. Similarly, although one can conceivably avoid being injected with a solution of a heavy metal as part of the treatment of disease, by removing oneself from the care of the doctor, therapeutics do not normally count as part of the environment unless they are removed from prescription control and placed in food or water.[8]

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[6] Ethel Browning, Toxicity of Industrial Metals, 2nd ed. (London: Butterworth, 1969), Chap. 3.

[7] U.S., Department of Health, Education, and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, National Air Pollution Control Administration, Air Quality Criteria for Sulphur Oxides, National Air Pollution Control Administration Publication AP-50, 1969, Chapter 8. The nature of the particles also has an effect on the degree of synergistic potentiation. Aerosols of soluble salts of iron II, manganese, and vanadium, for example, potentiate the irritant effect of sulfur dioxide by facilitating its oxidation to sulfuric acid, p. 111.

Generalization. When we examine other literature concerned with non-human components of the literal environment of humans we find that the same implicit criteria of unavoidability and non-deliberate (random) exposure apply. For example, an individual, if he is in the appropriate geographic locality, must be exposed to the components of the environment considered in the Study of Critical Environmental Problems (SCEP): carbon dioxide from fossil fuels; particles in the atmosphere; clouds from jet aircraft; climatic variation; persistent pesticides; heavy metal contamination of air and water; wastes from nuclear power plants; oil in the oceans; nutrient buildup in coastal waters; and atmospheric oxygen supply.[9]

The oxygen example is instructive. Empirical evidence that the supply of oxygen is not decreasing was obtained, and SCEP no longer considers the supply of atmospheric oxygen a possible environmental problem. However, although oxygen is not a problem it is part of the environment: a change in its atmospheric concentration would affect individuals; the changes would be unavoidable; and they would not be directed at a particular person. Thus, contrary to the impression that would be obtained from a cursory reading of the environmental literature, it is not necessary to show that a component of the environment has a present deleterious effect before that component can count as part of the environment.

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[8] Diethylstilbestrol residues in meat are one example. See Nicholas Wade, Science 177:588-591, 1972, for a news report of this and related controversies.

[9] Man's Impact on the Global Environment, Part I, passim.

Similar components to those investigated by SCEP are considered in other works that examine "man and his environment." Brubaker concentrates on "five major hazards": man's affect on global climate; radioactivity; pesticides; fertilizers; and erosion. He also considers air and water pollution, solid waste accumulation, and noise as burdens on the media upon which man depends.[10] This list is almost identical with the factors sketched in the First Annual Report of the U.S. Council on Environmental Quality, although land use is also included among the nonhuman components of environmental problems.[11] This additional component fits the criteria for inclusion in the environment that were established from the toxicology examples: any individual has little control over the way in which the available land is zoned and used; the zoning is not directed against a specific person (except occasionally when he is representative of a class of people, for instance, service station operators); and the effects of the zoning have unavoidable influences on the health and living patterns of the individual residents of the zoning area, and possibly those beyond it.

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[10] Sterling Brubaker, To Live on Earth: Man and His Environment in Perspective; A Resources for the Future Study (Baltimore: John Hopkins Press, 1972), passim and Table 6.

[11] U.S.,Council on Environmental Quality, Environmental Quality: The First Annual Report (Washington, D.C.: Government Printing Office, 1970), pp. 8-11.

In all of the examples used so far, the components that have been included in *the* environment have been the result of some action of man. However, this is not a necessary condition for inclusion in *the* environment. Mercury in seafood is considered part of *the* environment despite the probability that most of the mercury entering the sea at present comes from "natural" sources without the intervention of man.[12] Similar examples could be given of other substances which enter *the* environment both by human action *and* without human intervention. But even stronger evidence that *the* environment includes parts of the Universe that are never the result of human actions comes from geological examples. There are examples of the use of "*the* environment" when refering to geological structures that may result in earthquakes or tidal waves.[13] Crustal structures and phenomena such as earthquakes fit our criteria equally as well as the cases for which they were derived. The earthquake is unavoidable for a person living in the appropriate region; it is not directed at a specific person; and it affects the well-being of individuals.

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[12] "Except for coastal and estuarine areas it does not seem likely that man could have increased concentration /of mercury/ in the sea by as much as 1 percent." Allen L. Hammond, *Science* 171:788-789, 1971, p. 789.

[13] 'Environmental geology' has been defined to include "earthquakes, volcanism, landslides, and mud flows" as well as the geological factors in "waste disposal, water supply, land subsidence, mineral supply,coastal processes, and air and water pollution," (Kenneth N. Weaver, *Science* 172:1121, 1971). It has also been characterized as including planning to avoid natural hazards, aquire natural resources, and to use the land in the best possible way, (William R. Dickinson, *Journal of Geological Education* 18:194-197, 1970).

Criteria. For our entity (an individual human) and for our purposes (individual well-being) there are simple tests that can be applied to any non-human component of the total environment to determine whether it counts as part of the environment A component that satisfies all the following criteria will normally be considered as part of the environment:

1. The individual's well-being is potentially affected by the component.
2. Exposure to the component is inevitable.
3. The exposure is random and unintentional.

Other People as Components of The Environment?

The criteria of affect, inevitability, and randomness were developed by considering examples of non-human components of the Universe, external to the referent, that are considered part of the environment. Before these criteria are routinely applied to situations where 'other people' is a candidate for inclusion in the environment of an individual it is desirable that the effect of using them be checked in some appropriate examples.

It may be that for this special type of candidate component the criteria do not apply, either because they are not sufficient to discriminate positive and negative instances of people being part of the environment of Tom, or because discrimination is impossible: 'other people' may never be considered part of the environment. These possibilities will be considered by examining examples of the use of the criteria with instances where 'other people' could be considered a possible candidate for inclusion in the environment.

Affect. There is no doubt that it is necessary to include other individuals as part of the literal environment of Tom. They are parts of the Universe external to Tom, and are therefore parts of his environment. But to decide whether 'other people' count as part of the environment of Tom, it is necessary, under the criteria previously developed, to determine whether there are effects related to our purposes.

As in the case of non-human parts of the total environment considered above, if it is possible to demonstrate that the number, nature, and/or arrangement of other individuals affects the health of an individual, then we can consider cultural and sociological aspects of the surroundings of an individual as candidates for inclusion as components of the environment. (Note that cultural and sociological aspects of the life of an individual necessarily involve other people.) A different choice of entity, or a different purpose for considering the environment of an individual, may have led to a different position, and an affirmative answer to the empirical question "Is the health of an individual potentially affected by other individuals in his environment?" may not have allowed a conclusion of probable relevance to be drawn. The discussion below, therefore, applies only to the entity, and for the purpose, specified in this study.

Although there is clear evidence from other species that the presence of other individuals of the same species can have profound physiological effects, (for example the absence of males from a population of the fish Anthias squamipinnis causes a female to develop into a functional male, and, by successive loss of males, all females can be converted to males),[14] it is necessary to use evidence concerning Homo sapiens to evaluate the claim that other individuals are relevant environmental components of humans. Evidence from other species may suggest that the individuals surrounding a person may have physiological effects, but it is inconclusive.

Just as evidence of a potential effect of a chemical in the air on the health of an individual makes that chemical part of the environment, if there is a finite probability of an individual's health being affected by the presence or nature of other people then 'other people' is a firm candidate for inclusion in the environment.

Data concerning the effects on health of the presence of other people can be drawn from the body of research which indicates that the social milieu can produce direct physiological illness. One illuminating series of experiments has been conducted using United States sailors as subjects. In these studies of the crews of individual vessels it was shown that illness is related to the setting. Illness rates decreased in an attack carrier in the Pacific theater during the period of sudden non-physical stress that followed the Peublo incident. A similar decrease occured in the crew of the battleship New Jersey when it was ordered back to the Western Pacific following the shooting down of a navy plane by a North Korean patrol, even though the ship was almost home at the end of a tour of active duty off Vietnam. In all ships studied, the illness rates during travel to, and in, the first combat patrol has been found to be relatively low compared to the rate on subsequent patrols. The first period is a novel experience for most of the men; later patrols are repetitious, and apparently less stressful.[15] It might be argued that these results are not related to the question of relevance of interpersonal relationships as components of the environment, both because of the possibility of confusing illness with the incidence of reporting illness, and because these illness variations are not related directly to the presence of other men in the environment. The first objection is possibly valid, and reflects the difficulty of collecting valid medical data on minor illnesses in a natural versus laboratory setting; self-report is necessary. The second objection has less weight: the sailors were not under direct physical environmental stresses of, for example, gunnery, during the periods of travel to station off the Vietnam coast. But they were necessarily subjected to the social and psychological stress of the unknown during that period.

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[14] Lev Fishelson, Nature 227:90, 1970.

More direct evidence of the effect of interpersonal relationships on the health of these sailors is provided in another paper in the same series. The total life change units accumulated prior to embarkation are related to the probability of illness during the period of the cruise. These units are derived from an empirical weighting of the recent occurence of events such as marriage, death of a relative, change in social activities, and the like.[16] Studies in populations of children support the general principle that changes in the nature of the human environment of an individual, as measured by life change units, are related to physiological illness patterns. Even after removing the effects of hospitalization on the life change units score, Columbus, Ohio, children who had been in hospital in the year prior to being interviewed, as part of a sample of normal children, had a significantly higher life change score than the rest of the sample.[17]

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[15] Robert T. Rubin, E.K. Eric Gunderson, and Richard E. Doll, Archives of Environmental Health 19:740-757, 1969; Robert T. Rubin, E.K. Eric Gunderson, and Ransom J. Arthur, Journal of Psychosomatic Research 15:277-288, 1971.

[16] Robert T. Rubin, E.K.E. Gunderson, and Ransom J. Arthur, Journal of Psychosomatic Research 15:89-94, 1971.

In addition to this evidence for physiological effects due to other people, there is some evidence of variation in personal danger associated with different social environments within the United States. For example, the probability of being a murder victim varies between the states. Aside from the correlation of homicide rates with urban density, which is an example of the effect of the arrangement of other people in the environment of an individual, there is evidence that the degree of "southerness" of a state is a good predictor of homicide rates, both for blacks and whites. In these particular data geographic variables of climate and latitude have been ruled out as major explanatory variables because patterns of migration from the Southern States to the remainder of the country were used in deriving the index of southerness, not proximity to the south.[18] That is, variation in the nature of the human component of an individual's environment influences the chance of death of that individual.

The evidence presented above shows that the nature of the human components of the environment of an individual can have effects on his well-being. There are also a number of studies that suggest that the arrangement of persons in the environment can have health effects. Galle and his co-workers, for example, investigated the relationship between density (persons per acre or persons per room) and indicators of social pathology in Chcago.[19] Although their technique does not allow cause and effect relationships to be determined, they present some evidence to support the possibility of relationships between density and factors such as the standard mortality rate, fertility rate, and admissions to mental hospitals. They have demonstrated that there is a prima facie case for considering the density of other persons in the surroundings as a relevant environmental variable, although there may be other effects confounded with density, (social structure, for example) that may be the direct causes of the relationships.

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[17] R. Dean Coddington, Journal of Psychosomatic Research 16:205-213, 1972.

[18] Raymond D. Gastil, American Sociological Review 36:412-427, 1971. "Southerness" is the author's spelling.

The studies cited so far have been chosen because of their evidence of relatively subtle effects of other persons on physiological well-being. More direct effects are common knowledge: the transmission of disease from person to person, including, but not limited to, cases similar to "Typhoid Mary" and venereal disease; the necessity for parental care of infants, either by the biological parents or surrogates; the effect of the physiology of a driver and his state of mind on the chances of a motor vehicle accident killing or injuring other people; and the necessary presence and involvement of other individuals for a state of war to exist. All of these more direct examples illustrate that other individuals can, and do, have an influence on the physiological well-being of any person.

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[19] Omer R. Galle et al., Science 176:23-30, 1972.

Inevitability. In all of the examples used in the preceding section the exposure to the other people in the environment of the individual is inevitable, given his geographic locality. Sailors cannot escape the crew of their vessel; children are necessarily exposed to parents, teachers, peers, and usually siblings; a person has no control over the "southerness" of the state in which he lives; the density of a population is a function of zoning laws, history, and political factors, and a person has to choose his abode from within the options that these influences allow; and war, the nature of one's parents, and the sobriety of other drivers are all factors that are uncontrollable by the individual human. Although the cases used in demonstrating the physiological *effects* of other people also fit the criterion of *inevitability*, this is not sufficient evidence that this criterion is effective and appropriate in cases where humans are being considered for inclusion in *the* environment. Indeed, the possibility of ruling out any examples involving other humans by applying this criterion seems remote: there is no way in which any person can avoid some contact with his fellows at some time in his life.

Randomness. The criterion of randomness, or non-deliberate exposure, is a little more difficult to apply to 'other humans' than it is in the case of physical components of the total environment. At first sight it appears that the examples given previously to illustrate the criteria of affect and inevitability could be ruled out by the application of the criterion of randomness. There is no doubt that the life change units incurred on the death of a parent can apply only to the children of that person, or that a murder victim in a state with a high index of southerness is uually not a casualty of a chance shot from a haphazard sniper.

However, it is very difficult to argue that the death of a parent is deliberately intended to affect the child; but the murderer *is* deliberate in his aim. This criterion, when applied to 'other people' in the total environment of an individual, can distinguish between cases that at first appear to be possible candidates for inclusion in *the* environment. Of the examples used in the preceding sections, the following would be ruled out by the application of this criterion: chances of violent death in States with a high degree of southerness; warfare; and parental care of infants. The other examples, (psychosomatic effects in warships, Columbus children, and, possibly, Chicago crowded areas; exposure to venereal disease; "Typhoid Mary" cases; and drunken drivers), remain as candidates for inclusion in *the* environment.

Applicability of Criteria. The preceding discussion shows that there are instances where 'other people' fit the criteria for inclusion in *the* environment that operate satisfactorily when non-human components are concerned. However, two of them seem to be criteria that would fit *any* example of the presence of others in the environment. There is little difficulty in seeing that the inevitability criterion fits *if* the potential for an effect on my well-being is an attribute of every human. I can scarcely evade contact with people, even if I attempt to be a modern-day hermit. If, therefore, every human has a potential effect on my well-being, both the criteria of affect and inevitability apply in all my dealings with other individuals in my total environment.

At first sight it might appear that not all humans have the potential for an effect on my well-being. The best seal hunter in Thule, a Fore tribesman of New Guinea, the grocer's wife in Hammersmith, and the lighthouse keeper at Wilson's Promontory, will probably have no effect on my well-being while I am writing in my office in Columbus. It is most unlikely that anyone would refer to these people as part of the environment in which I live. But their status may change. If I decide to take a sea voyage, the lighthouse keeper could become exceedingly important to my well-being. They are potentially able to have an effect on my chances of survival. As we have seen before it is essential to retain the "potentially able" part of the criterion. If we removed it, we could not justify including as part of the environment many of the undisputed physical components normally included, gamma radiation for example, although there is little direct evidence of effects at the low "environmental" levels.

Only the application of the third criterion, non-deliberate random exposure, may enable us to distinguish instances where 'other people' is not identified as part of the environment. However, these criteria were developed for use with non-human components of the total environment. We have not yet demonstrated that they are usefully applied to 'other humans'. They will be useful only if they identify actual instances of the use of 'other people' as part of the environment in environmental discussions.

Instances of the use of "the environment" to include other people in the surroundings of an individual are very difficult to find. Even in papers written by social scientists who are interested in the environment, the group of scientists that would be expected to be concerned with other people as parts of the environment of individuals, most references are to the sociological and psychological consequences of the arrangement of non-human parts of the Universe. In Environment and the Social Sciences: Perspectives and Applications,[20] for example, the topics discussed include responses to air pollution, considering such aspects as the pain thresholds for particular components of smog,[21] and techniques and results of measurement of public responses toward air pollution;[22] the effect of various forms of instititional settings, including architectural parameters, on human behavior, particularly in prisons, psychiatric wards, and homes for the aged;[23] parameters of resident well-being and perception of social identity in large-scale public housing projects, slums, and new-town developments, described mainly in terms of the architectural and town-planning design of the facilities;[24] and the characteristics of recreational areas, in residential, camping, and wilderness regions, that contribute to the satisfaction of users.[25] Most of these authors refrain from using the term "environment" in an unqualified way; they almost always refer to the residential environment, the institutional environment, or the prison environment. The only suggestion that the work of these authors is relevant to a discussion of 'the environment', as that term is used in current discourse, is their appearance in a volume whose editors selected papers that provided "a reasonably representative coverage of environmental problems to whose solutions social scientists have been making contributions."[26] The American Psychological Association and the editors felt that "psychology had a substantial contribution to make to a better understanding of our present-day environmental problems and to a more effective approach in dealing with them. . . /̄ the papers were particularly addressed to_7 individuals and organizations who have become active in the world-wide movement to 'clean up' our environment or preserve its quality."[27]

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[20] Joachim F. Wohlwill and Daniel H. Carson, eds. (Washington, D.C.: American Psychological Society, 1972).

[21] Margaret Hubbard Jones, in Environment and the Social Sciences.

[22] James A. Swan, in Environment and the Social Sciences.

[23] Daniel Glaser, in Environment and the Social Sciences; William H. Ittleson, Harold M. Proshansky, and Leanne G. Rivlin, ibid; and M. Powell Lawton, ibid.

[24] William L. Yancey, in Environment and the Social Sciences; Marc Fried and Peggy Gleicher, ibid.; and Robert B. Zehner, ibid.

[25] Robert W. Marans, in Environment and the Social Sciences; David W. Lime, ibid.; and Elwood L. Shafer, Jr., and James Mietz, ibid.

The papers in Environment and the Social Sciences: Perspectives and Applications that are refered to above illustrate a most important point. Although 'other people' may not be included as part of the environment, it does not follow that 'other people' need not be considered when discussing the environment of an individual. 'Other people' have a great influence on the environment, being implicated in the causes of "environmental problems" and detracting from the individual's enjoyment of the environment. Swan, for example, calls air, water, and pesticide pollution "man induced environmental problems,"[28] Buckhout calls for direct attempts to influence the community to help eliminate problems of the environment caused by complacency and indifference,[29] and Proshansky et al consider the role of privacy, territoriality, and crowding in the "behavior and experience of the individual in relation to the nature and organization of the physical environment."[30]

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[26] Environment and the Social Sciences, p. vi.

[27] Ibid., p. v.

[28] James A. Swan, in Environment and the Social Sciences, p. 67.

Cases such as these where humans are considered in relation to the environment of individuals concern their involvement as causes of environmental problems. For example, "too many people" give rise to "too much waste" (industrial and biological) for the environment to absorb. In this type of reference to other humans in Tom's environment it is the affected components of the non-human biophysical environment that are being considered as parts of the environment. Similarly, it is the nitrogen oxides and hydrocarbons that they produce, not the cars themselves, that are considered part of the environment. (The fact that there is a search for a "non-polluting" car, rather than a move to outlaw cars, supports this view. It is not biologically possible for people to be "non-polluting," so the strategy is to advocate less people).

"Juvenile delinquents are a product of their environment" usually suggests that the physical setting and the social situation in which children are raised helps explain the development of "anti-social behavior." The children are inevitably exposed to the social conditions in which they are raised, are inevitably affected by the people around them, and, despite the inevitability of the exposure, the potential delinquents are not specific targets of deliberately created social conditions. This instance fits the criteria proposed earlier,and would seem to be a case where 'other people' might actually be considered part of the environment.

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[29] Robert Buckhout, in Environment and the Social Sciences.

[30] Harold M. Proshansky, William H, Ittleson, and Leanne G. Rivlin, in Environment and the Social Sciences, p. 31.

Little support for this interpretation is given in the paper "The Importance of Environment in Child Rearing."[31] After discussion of previous studies Schaller concludes that adequate evidence is available to support the generalization that there are differences in child rearing habits between rural and town inhabitants, and that the physical setting of dwellings in these areas may have an effect on the development of traditions and the effect of these traditions on individuals. But, it is claimed, "several other factors (e.g., composition of families, neighborhoods and other social groups), will lead to variations in upbringing methods."[32] That is, it is implied that the strictly social factors are not components of the childrearing environment. This implication is reinforced in the discussion of the results obtained when children's reports of their parents' practices were compared across rural, suburban, and apartment-house areas: "it is impossible to draw any conclusions as to whether the observed differences between the various living environments are caused by environmental factors, or whether it may be that people with a certain attitude to child upbringing have a stronger tendency to move to villa areas than others, or whether it is just a case of interaction between these two factors."[33] Schaller clearly recogn [illegible] the importance of parental attitudes to child rearing practices, yet [illegible] does not include parents in *the* environment.

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[31] Joseph Schaller, Göteborg Psychological Reports 2(2):1-11, 1972.

[32] Ibid., p. 3.

[33] Ibid., p. 10

The foregoing analysis of the relatively "academic" literature on *the* environment suggests that the criteria that satisfactorily identify the non-human parts of the total environment of an individual that are currently considered to constitute *the* environment fail when applied to 'other people'. This failure is not due to a lack of discriminatory power when the criteria are applied in this case. The failure occurs because 'other people' are *not* considered part of *the* environment, even in cases that fit the criteria. This may be because professionals concerned with *the* environment are inclined to treat humans as *causes* of the non-human environmental problems, and to concentrate on the actual problems when writing of "*the* environment." The apparent distinction between (human) causes and (non-human) problems of *the* environment in the examples cited lends credence to this idea.

There are some pragmatic reasons for excluding 'other people' from *the* environment. For example, one "environmental studies institute" attached to a major U.S. university concentrates on investigations of the interface of man and his physical environment, despite the recognition by the staff that social components of the total environment are very important influences on the life of individuals. These human components are left to the sociologists, who will continue to study the relationships of people as social groups; the psychologists, who investigate different aspects of an individual's response to his fellows; and the medical scientists who are interested in the physiological and pathological aspects of such relationships. For reasons of efficiency and expediency this institute excludes many social factors from its apparent use of *the* environment.[34]

Brubaker also uses pragmatic reasons to exclude specific human components from consideration of *the* environment, but points out that even with this exclusion "man's values, aspirations, technology and social organization condition the result"[35] of human modifications to the physical environment. Thus, although man-man systems are not refered to under "*the* environment," sociological and psychological research has some relevant input into studies of *the* environment, particularly in the investigations of the causes of changes in the air, water, and land.

Other objections to the inclusion of humans in *the* environment of an individual are related to the concern that the broad definition that this course would produce would convey little information. It was felt by some participants in a conference discussion of environmental problems and their relation to education that restriction of "*the* environment" to the physical components--the air, the water, the land, and the structure of cities, for example--would be more precise. The biotic surroundings of man would also be included by many, for disease and sustenance involve other organisms. But, it was feared, the inclusion of 'other men' would decrease the information content too much, and effectively make the term all-embracing. This would result in *the* environment becoming a concept without any non-members, and it would have little use in communication.[36]

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[34] Unpublished transcript of the proceedings of the conference "Environmental Problems and Education," Lake Hope, Ohio, May, 1972.

[35] Sterling Brubaker, *To Live on Earth: Man and His Environment in Perspective*. A Resouces for the Future Study (Baltimore: Johns Hopkins Press, 1972), p. 4.

A person committed to the view that the inclusion of social and cultural variables is detrimental to the precision of 'the environment' could increase the information content of the current discourse by advocating and practicing usage such as "the physical environment of individuals," "the biotic environment of New Yorkers," "the microbiological environment of hospital patients," and "the social environment of the school child." That is, he could specify the entity and the portion of the environment with which he is concerned. But such qualifications are usually neglected, and the unqualified term is perpetuated in the literature. Therefore, if we are to reflect the usage of 'the environment' in the formal literature, we must exclude other people as direct components of the environment of the individual.

The same distinction need not hold in every-day lay usage. An examination of ordinary language and of the popular press may indicate that there are indeed cases where 'other people' are considered part of the environment. If this is the case, we will need to add an additional criterion to determine whether a particular instance fits the usage of 'the environment': the nature of the user. Although this procedure appears inelegant, and could result in the same situation being considered as an instance of 'other people' being part of the environment by a layman, and not a part by a professional, this criterion is not inappropriate. In Chapter II we used an equivalent criterion to determine relevance of any component of the total environment:

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[36] Unpublished transcript of the proceedings of the conference "Environmental Problems and Education," Lake Hope, Ohio, May, 1972.

relevance depends upon the purpose of the user, and the purpose varies with the user.

"The environment that produce William Brown and Thomas Grey" suggests that the biographer is considering all of the influences that affected his subject--physical, social, and economic. Similarly, when we speak of taking young persons from the environment in which they were raised and placing them in an environment where they will, perhaps, be favourably influenced by their peers, we are including social factors, i.e., 'other people' are considered part of the environment. In these cases, however, we are speaking of influences on the subjects' "character" or "personality," not necessarily on any other aspects of their well-being.

But, when we speak of "environmental problems" or of "protecting the environment" every-day language excludes 'other people' from the unqualified use of 'the environment'. No reference that could be construed as including 'other people' as a relevant component of the environment being considered could be found in Time or the New York Times.[37] The environmental problems being discussed were typically pollution, resources, energy supply, waste disposal, food supply for an increasing population, or man-made climatic changes. Even in the article which could be expected to include 'other people' as part of the environment

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[37] The "Environment" section of Time was examined for February-April, 1970, March-April, 1971, and January-June, 1972. The New York Times Index was scanned for 1970 and January-June, 1971. Possible references were checked. No instance of the use of 'other people' as part of the environment was found in editorials or news items.

Time did not vary its usage: in "Ecology of a Ghetto"[38] the environmental problems described were those of public health resulting from the condition of the buildings and the presence of vermin, of noise, and of dirt. It might be possible, by an extremely broad stretch of meaning, to claim that the *Time* article was including 'other people' in *the* environment when it discussed the effect of various laws (public assistance, Federal housing programs, and the like) on the mobility of the poor. 'Other people' pass and administer these laws, and it would be possible to consider them part of *the* environment. However, there is no strong evidence that the *Time* writer made this inference.

Except for lay discussions of the generalized influences on the psychological development of the individual, 'other people' does not normally count as a component of *the* environment. Unless this is the purpose of a discussion it is very unlikely that a lay use of '*the* environment' carries any connotation of 'other people' as a relevant component. The implicit lay and professional definitions are, therefore, similar in most current uses of the term. Indeed, just as in the professional literature, 'other people' may be seen as *causes* of factors in *the* environment, (see the *Time* article mentioned above), and social factors will almost invariably enter a lay discussion as we have seen they do in the professional literature. Thus, except for the one special case considered above, there is no need to establish an additional criterion for use with lay discussions. The criteria of affect, inevitability, and randomness are not used in either lay or professional cases, for 'other people' are not considered part of *the* environment.

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[38] *Time*, April 6, 1970, p. 48-53.

Aberrant Case

There is one relatively common use of '*the* environment' that at first glance does not seem to fit the analysis made in this chapter. However, an examination of the context reveals that it is an instance of a logically fallacious case used in a slogan-like manner.

Is Man Part of his own Environment? Some authors state or imply that man is part of his own environment. The International Union for the Conservation of Nature (IUCN) defines conservation as "management of the resources of the environment--air, water, soil, minerals and living species including man--so as to achieve the highest sustainable quality of human life."[39] That is, man is specifically included as part of the environment. The referent of 'environment' is not specified, but the purpose given for conservation--achieving the highest quality human life--implies that it is man. Thus man is considered part of the environment of man.

It is possible to make literal sense of the IUCN definition if we interpret 'man' in the individual, rather than the generic, sense. We can then claim that the definition is refering to other people in the environment of an individual. Apart from the unfortunate implication of managing other men to achieve the highest quality of life for oneself that this position yields, the interpretation of "living species including man" as a reference to one individual man requires stretching the meaning unreasonably.

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[39] Quoted by Gerardo Budowski, IUCN Director-General, in "Enviromental Conservation for Development and the Relevant Role of Education," (Paper presented to the International Workshop on Environmental Studies in Higher Education and Teacher Training, University of Western Ontario, London, Ontario, September 1972), p. 4.

The interpretation of 'man' as a reference to an individual person is even less reasonable in Roth's statement that

> in the past we have relied on the environmental pyramid depicted by Odum and others that progressed from the abiotic to the biotic and concluded with man on top. I am suggesting that the pressure of living, our increased population, our finite resource supplies, and the cycle of production of goods and waste, has altered that form of simplistic relationship. Man is reduced from the role of "dominant" or "master" in the Judeo-Christian ethical sense to a lower state of existence. He is part of the environment.[40]

Elsewhere in the same article Roth implies that the purpose of environmental education is to safeguard an environment that is "optimal for living," taking into account "human needs."[41] He is, therefore, concerned with the environment of man. Can his statement that man "is part of the environment" be reconciled with the logical position that an entity cannot be part of its own environment?

It is clear that man is part of an interrelated system of man, culture, and the biophysical environment; that is, he is part of the human ecosystem. But man and his environment are logically distinct parts of the ecosystem, although man influences and is influenced by his surroundings. The dilemma could be solved if Roth was confusing 'environment' with 'system' in his statement. This interpretation appears to be supported by the apparent logical error in part of his definition of environmental education: "knowledge of the interrelated biophysical and sociocultural environments of which man is a part."[42]

However, these statements are included in an article whose main intent is to stimulate teachers to include the interactions between man and his environment in their curricula, rather than consider man as above the biotic part of the Universe. Given this purpose, "man is part of the environment" is best interpreted as a slogan, rather than a proposition of truth. Roth's stress on this point serves to redirect the attention of teachers, causing them to consider the implications of their instructional emphasis on the natural surroundings as something with little affect on man. This redirection, Roth suggests, should take the form of an emphasis on the "land ethic;" that man is responsible for the maintenance of the integrity of the land, for on this integrity his survival depends.

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[40] Robert E. Roth, in Outlines of Environmental Education, ed. Clay Schoenfeld (Madison, Wisconsin: Dembar Educational Research Services, 1971), p. 97. (Emphasis added.)

[41] Ibid. [42] Ibid. (Emphasis added.)

As Scheffler points out, an educational slogan can be effective and have "practical relevance" even though it cannot survive analysis as a literal statement. Roth's statements can, if they are interpreted as educational slogans, be a useful tool for effecting change in the curriculum offered by teachers in our schools, but they need not be, and cannot be, taken to imply that man is literally part of his own environment.

McInnes takes a much more extreme position than Roth. He begins by accepting a definition of 'environment' that states that "an environment is anything which is influencing, or being influenced by, something else."[43] According to this definition there is a multiplicity of environments. In a classroom, for instance, the teacher is "one--but *only* one--of [his] students' immediate environments. They, in turn, represent several different immediate environments of [the teacher] and of one another."[44] He then argues that since an individual is influenced by everything upon which he has an influence, and that the only thing which all his environments have in common is himself, "the answer to the question about *whose* environment you are [is] *you are your own environments*."[45]

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[43] Noel McInnes, You are an Environment: Teaching/Learning Environmental Attitudes (Evanston, Illinois: Center for Curriculum Design, 1972), p. 48.

In addition to the non sequitur leading to the statement that one is one's own environments, there is a major difficulty with McInnes' position. This difficulty stems from the basic definition being used. It is a functional definition, rather than a positional one. Since everything in the Universe is influenced by and influences every other thing, at least by gravitational forces, there must be an infinite number of environments. This gives us little information. Since, by McInnes' own admission, 'environment' is perceived by most people as something separate from some entity,[46] changing the definition so drastically from the standard usage will not even produce a useful slogan. "You are an environment" will not convey the interactive, functional viewpoint if most people interpret environment in a positional sense.

Both Roth and McInnes are concerned with emphasizing a very important practical point. They wish to indicate the importance of considering interactions between man and his surroundings. McInnes believes that the standard positional interpretation [illegible] 'environment' leads to the tendency "to perceive ourselves, and consequently behave ourselves, as separate from rather than at one with our environments."[47] Even if he is correct, and people tend to ignore their own influence on their surroundings if "environment" is emphasized in policy discussions, the solution is surely not to attempt to change the meaning of 'environment' so that the interactions between entities are included in the connotations of the term. Emphasizing policy for the 'man/environment system', rather than continually discussing actions related to 'environment' would achieve the same end without abusing the language and confusing the issue by attempting to drastically alter the sense of the term. Although not literally sensible, Roth's slogan "man is part of his own environment" is less likely to mislead than McInnes' "you are your own environments." At least Roth's use of 'environment' is still positional.

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[44] Ibid., p. 49. [45] Ibid., p. 53. [46] Ibid., p. 47.

Summary

A component of the total environment of an individual counts as part of the environment if the individual's well-being is potentially affected by the component, if the exposure to the component is inevitable, and if the exposure is unintentional. There is one major exception to this conclusion. Although the criteria are met, 'other people' are not considered part of the environment, except in lay discussions of the generalized influences on psychological development of individuals.

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[47] Ibid., p. 46.

CHAPTER V

INTERPRETATIONS OF 'ENVIRONMENTAL EDUCATION'

The label "environmental education" makes literal sense when applied to a number of different classes of educative programs. It can refer to education about the environment, for the (preservation of the) environment, or in the environment. Combinations of any two or all three of these possibilities are also sensible. It is meaningful to speak of education about the environment being conducted in the environment, and of education about the environment being designed for preservation of the environment. It is also meaningful to speak of education about the environment being conducted in the environment so that the learner will attempt to preserve the environment. But the label "environmental education" does not necessarily entail any particular one of these possibilities.

Compounding the confusion created by the different classes of programs that could logically fall under 'environmental education' is the possibility that any one of a multiplicity of selections from the total environment could be used as the relevant 'environment' in an 'environmental education' program. Similarly, there is a range of logical possibilities from which the entity used as the referent of 'environment' can be drawn. To realize the diversity of possible logically distinct types of 'environmental education', imagine a relatively restricted set of possibilities: consider only the case where an individual human is the entity used as the referent for 'environment' and restrict the relevant selections from his total environment to the environment (in the sense of Chapter IV), the urban environment, the family environment, the business environment, the agrarian environment, the cultural environment, the living environment, or the architectural environment. These eight relevant sub-sets of the total environment, together with the seven logically possible classes of program, (in, about, and for the environment, together with the four possible combinations), leads to fifty-six logically distinct types of sensible use of 'environmental education'. If we allow the possibility that 'environmental education' may also refer to instances where the referent is 'the population of Columbus, Ohio', we find that we have over one hundred logically distinct possible programs that would sensibly fit the rubric 'environmental education'. This number is a conservative estimate, for not all possible referents of 'environment', or all possible combinations of components of the total environment that could be considered relevant (and thus be the 'environment' in 'environmental education') have been considered.

To avoid the possible ambiguities demonstrated above any full definition of "environmental education" should specify the class of program (in, about, or for the environment, or the combination classes), the entity used as referent, (e.g. the human species, the population of France, or the individual human), and the parts of the total environment of that entity that are considered relevant by the definer. Explicit definitions that include all of these data will reduce the need to infer the actual meaning of the writer and should reduce misunderstanding. As well as acting as a stipulative definition (stating how 'environmental education' is to be understood in the ensuing discussion), such a definition is often, in Scheffler's terminology, programmatic, conveying some indication of the practical consequences of accepting the definition.[1] For example, a definition that explicitly stated that the writer considered environmental education to be 'for the preservation of the environment' would imply that a particular class of goals would be included in the program. The program implied by a definition that restricted environmental education to 'education about the environment' would be quite different from one that included a compound program, for and about the environment.

Differences between the implied goals of programs based on definitions including the seven different classes of environmental education are examined in the first section of this chapter. In the second section, selected examples from the literature concerning environmental education are given to illustrate the diversity of existing definitions and programs. In addition, the examples chosen include an account of some of the disputes concerning the appropriateness of particular classes of environmental education programs.

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[1] Israel Scheffler, The Language of Education (Springfield, Illinois: Thomas, 1960), Chapter I.

CHARACTERISTICS OF THE CLASSES OF ENVIRONMENTAL EDUCATION

In this section the features that characterize each of the primary classes of environmental education--education _about_, _for_ (the preservation of), and _in_ the environment--are established and contrasted. The effects of combining these features on the characteristics of the compound classes are then considered. Since the same conclusions hold whether we consider _the_ environment, or a qualified part of the total environment such as the _urban_ environment, the _family_ environment, or the _biotic_ environment, the particular use of 'environment' by the environmental educators cited is of little concern in this section. The subject matter of their courses would depend upon the manner in which they used 'environment', but subject matter does not affect the _type_ of goals implied by each class of environmental education.

Characteristics of the Basic Classes of Environmental Education

Education About the Environment. Educational programs designed to provide information concerning the environment are members of the class 'education about the environment'. Their objectives are clearly _cognitive_ in the terminology used by Bloom _et al_.[2] Possible programs are not restricted to those that expect the student merely to recall a series of previously presented facts about the environment. All of the cognitive levels in Bloom's taxonomy may be represented in programs that are members of this class: students may be expected to comprehend and interpret environmental data; to analyse environmental situations into the component principles; to synthesize explanations likely to account for an environmental phenomenon that is new to the student; and to evaluate environmental data and phenomena, and, perhaps, the consequences of proposed manipulations in terms of the likely environmental responses. (Evaluate is used here in Bloom's technical sense and does not entail value judgements, either moral or aesthetic.)

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[2] Benjamin S. Bloom, ed. _Taxonomy of Educational Objectives: The Classification of Educational Goals_. Handbook 1: Cognitive Domain (New York: David McKay, 1956).

'Education about the environment' does not imply that we already have a complete understanding of the nature of the environment and that it is the educator's function merely to pass this information to his students. Teaching the intellectual and technical skills necessary for investigating the nature of the environment is compatible with the notion of teaching about the environment, particularly if the general educational goal of preparing students for life-long learning is accepted.

Indeed, it can be argued that education about the environment would be incomplete unless some attempt is made to teach skills for gaining environmental information. It is not unreasonable to say that one fact about the environment is that techniques A, B, C . . . and N allow the nature of the environment to be determined. The techniques for which A - N are symbols cannot be specified here, for they depend upon the particular set of components of the Universe external to the entity that are considered relevant, and which are refered to as 'environment' by the educator concerned. But if the educator is interested in the biotic environment of individual humans, then one intellectual technique that may be applied to provide information about the identity of a micro-organism causing a particular disease is the systematic testing of Koch's postulates. Opinionnaires and unobtrusive measures might be appropriate techniques to teach if the educator was focusing on the social or architectural environment.

Programs that do not include all possible information about the particular 'environment' being considered are valid members of the class 'education about the environment'. No one can pretend that it is desirable to attempt, or possible to achieve, a program that would teach someone everything about the environment. It seems a pointless exercise, and, in any case, we do not know everything about the total environment, or, probably, about any subset of it that is considered in environmental education programs. Thus, a program that omits consideration of techniques may still be considered a valid member of the class 'education about the environment'. Similarly, there is no necessity for programs about the environment to include objectives at all levels of Bloom's taxonomy to qualify as an example of 'environmental education'.

In Chapter II it was shown that there are cases where the purpose of considering an entity's environment may have nothing to do with the effects of the environment and the entity on each other. Similarly, it is logically possible for a curriculum developed to provide information solely about the environment to belong in the class 'education about the environment'. In most cases, however, interactions between the entity and the environment would be considered part of the subject matter for this type of environmental education. Consideration of interaction of entity and environment also fits the concept of 'education about the environment', for data concerning the effects that components of the environment have on the entity, and vice versa, are valid information about the environment.

Education for the Environment. The programs of education for the environment aim to assist the preservation or improvement of the environment for a particular purpose; contrast this with education about the environment where the goal is a knowledgeable individual. Typically programs for the environment will attempt to inculcate attitudes of concern for the features of the environment that enhance the chances of continued human life, which enhance the quality of man's life, or which are claimed to have value in and of themselves.

The use of 'attitude' is potentially misleading. 'Opinion', 'attitude', 'interest', and 'value' are sometimes considered to represent successive points on a single continuum; values may be considered to be components of attitudes; 'attitude' and 'opinion' are sometimes used as if 'attitude' is a general orientation and 'opinion' is a more specific manifestation of the broad attitude; and 'attitudes' may be used to refer to matters of taste, while 'opinions' are held to concern matters of fact.[3] In the environmental education literature cited in this and the next chapter, however, these distinctions are not made.

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[3] See William J. McGuire, in The Handbook of Social Psychology. 2nd ed., ed. Gardner Lindzey and Elliot Aronson (Reading, Mass.: Addison-Wesley, 1969), vol. 3, pp. 150-153, for a discussion of these distinctions. Additional interpretations are presented by Anthony G. Greenwald, in Psychological Foundations of Attitudes, ed. Anthony G. Greenwald et al (New York: Academic Press, 1968), pp. 361-364.

Almost invariably, 'attitude' denotes, or at least connotes, 'a predisposition to act'. Thus, if one of the specific objectives of the educator is to inculcate an attitude toward conservation of energy resources he intends to produce a predisposition to limit the use of electrical power, by turning off electric lights in rooms not being used, for example. This 'predisposition to act' sense of 'attitude' is used in this and the following chapters.

Although attitudinal objectives are typical of programs in the class 'education for the environment', they are not necessarily the only type of objective that such programs may have. Programs could have goals that include producing particular overt behaviors, perhaps habitual responses. Some educators may consider goals of this type necessary and valid because there is no guarantee that developing particular attitudes will result in the desired end of a preserved or enhanced environment for man.

The actual behavior of a person, if it is influenced by the attitudes that he holds, will depend upon the weighting given to conflicting sets of attitudes. For example, Strong reports a case where a majority of a community expressed an opinion consistent with an attitude of conservation and preservation of the countryside. However, the regional plan that would ensure this state of affairs was not implemented: "support for clean and ample water, for preserving the beauty of the countryside, and for fertile farms and fine fishing was about unanimous . . . no one wanted subdivisions, trailers, shopping centers, or factories next door or down the road. But many, and maybe most, would want them on their own land if the price were right."[4]

Since the goal of education for the environment is to produce a "quality" environment, citizens must be provided with the skills that are necessary to achieve this end. In some cases, these skills are professional technical abilities appropriate for water-quality control engineers, air pollution enforcement officers, natural-resource economists, or agronomists. In other cases, more general citizen skills are needed: methods of making and influencing public policy, of finding information concerning environmental issues, and of estimating the environmental impact of alternate methods of satisfying personal needs. These skills will be among those needed to facilitate the maintenance of environmental quality.

Education for the environment need not be directly aimed at both attitudes and skills, although it may be more successful if both favorable attitudes and competence in appropriate skills are explicit aims of the course. Technical education of environmental managers provides evidence that there is no logical necessity for attitude development to be included in programs that qualify as education for the environment. One can easily imagine training an air pollution technician in all of the skills needed to operate monitoring equipment accurately, to determine when the law concerning emissions may be being violated, and thus to recognize when and where measurements are needed for law enforcement. This technician need not have developed any attitudes of concern for the quality of the air; he may be "coerced" into carrying out his duties by threat of dismissal or of legal action if he provides favored treatment for a particular industry. Thus a program of education for the preservation of the environment could conceivably meet its goals without ever considering attitude development.

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[4] Ann Louise Strong, in America's Changing Environment, ed. Roger Revelle and Hans H. Landsberg (Boston: Beacon Press, 1970), p. 89.

It is an empirical question whether development of attitudes of concern for the environment increases the effectiveness of programs for the development of a quality environment. But it is essential that the products of this class of environmental education have the necessary skills, either professional or general, and intellectual or practical.

The example of training an environmental technician used above also demonstrates the logical distinctness of education about and education for the environment. The technician need not be taught anything about the environment with which he is concerned professionally. He need not know of the effects of air pollutants on human health, on green plant productivity, or on buildings and paintings. All he need be taught are skills; the correct operation of his instruments, and how to compare the results with a set of standards.

Education in the Environment. Education in the environment is characterized by the use of a particular pedagogical technique, whereas education about and education for the environment are characterized by the type of goals the programs have. Any program that took place in the environment would fit the logical criterion for this class. If we use the literal sense of environment, and consider the learner as the referent for 'environment', then all education except that which was purely introspective could sensibly be called "environmental education." However, 'environment' in 'education in the environment' usually refers to refer to this experimental project as an example of environmental education.[7]

In most cases, however, education in the environment is not the prime meaning of most programs now called "environmental education." This is true of some of the programs that were originally designed as outdoor education programs, e.g., the Conservation and Outdoor Education Program of the Ann Arbor Public Schools now stresses "the study of community natural resources under natural conditions" and is, therefore, an example of education in and about the environment.[8] Some of the original outdoor education programs were conceived as "a process of utilizing the outdoors as an integral part of the school curriculum,"[9] with the outdoors being used in different ways in instruction in different subjects.[10] Such programs would now be classified as 'education in the environment'. Other outdoor educators had goals that can be interpreted as education about the environment and/or education for the environment. Roth and Helgeson cite the following goals that were established by Fitzpatrick:

> To develop an awareness, an appreciation, and understanding of the natural environment and man's relation

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[7] See Donald William Cox, The City as a Schoolhouse: The Story of the Parkway Program (Valley Forge: Judson Press, 1972) for a history of the program. "Parkway Program," (The School District of Philadelphia, 1971), contains a brief description of the project.

[8] Review of Environmental Education for School Administrators, p. 38-39.

[9] Morris Wiener, Developing a Rationale for Outdoor Education (Ann Arbor, Mich.: University Microfilms, 1965), pp. 264-265.

[10] Ibid. p. 267.

> to it.
>
> To develop a sense of pride for the historical, educational, scientific, recreational, and inspirational values that are a part of his / the student's/ heritage.[11]

These goals are, respectively, examples of what would now be called education (mainly) about the environment and education both about and for the environment.

Outdoor education has also been interpreted in a manner consistent with an environmental education program about, in, and for the environment:

> The need to understand and appreciate the natural environment is the challenge of education . . . this can best be achieved . . . by going into the outdoors, learning the relationships of physical environment to plant life and to animal life including man. Only by association and knowledge can a generation of appreciative, concerned citizens perpetuate the small remnants of remaining natural areas and provide an environmental quality that makes life fit for living.[12]

Currently (1972) the Ohio Academy of Science is preparing another series of guides, expanding this definition to include social as well as physical environmental parameters, and broadening their goal beyond the perpetuation of the small remnants of natural areas. The guides will be for 'environmental education', rather than 'outdoor education'.[13]

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[11] Robert E. Roth and Stanley L. Helgeson, A Review of Research Related to Environmental Education. Environmental Education Information Reports, Research Review Series--Environmental Education, Paper 1 (Columbus, Ohio: The Ohio State University, ERIC Information Analysis Center for Science, Mathematics, and Environmnntal Education, 1972), p. 3.

[12] Ruth W. Melvin, A Guide to Ohio Outdoor Education Areas (Columbus, Ohio: State of Ohio Department of Natural Resources and the Ohio Academy of Science, 1970), p. iv.

[13] Barbara Thomson, personal communication.

Roth and Helgeson also cite other published goals for outdoor education, including the development of individual value systems, self-reliance, and personal aesthetic satisfaction.[14] These uses are, however, instances of the use of outdoor education as a pedagogic technique, for the personal characteristics intended to be developed are not necessarily directed toward the out-of-doors. These programs are equivalent to 'education in the environment'.

Given this diversity of original goals it is not surprising to find all of the logically possible classes of environmental education represented by programs that have developed from outdoor education projects, either by evolution of goals and approaches or by nomenclatural fiat.

Characteristics of the Compound Classes of Environmental Education

The goals of environmental education programs characterized by the combination of education in the environment with either education about or education for the environment are not different in principle from those of the two latter classes when considered alone. The specification of teaching technique merely reflects a pedagogic conviction that concrete representation of phenomena being discussed assists in the attainment of program goals. Students whose eyes stream from exposure to a high concentration of motor-car exhaust fumes may be more easily convinced that these compounds have a physiological effect, and, perhaps, that they should be reduced in intensity if possible; those who have had the opportunity to study regrowth in an old field over a period of months may have a better concept of succession than those who read about it in textbooks or see a film about the Indiana sand dunes. Similarly, the technique of educating outside the classroom in programs that attempt to teach about the environment and for its preservation adds little to the characteristics of the course goals. Educating in the environment merely adds another parameter without changing the substantive goals.

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[14] Review of Research Related to Environmental Education, p. 4.

But the goals of programs that educate about the environment and for the environment are not simply additive. If there was a simple addition the goals of knowing about and acting for the preservation of the environment would be equal. However, this is not necessarily so. Normally one or other of the goals is of primary importance to the educator. It may be the information about the environment that is emphasized, in the hope that concern will be generated by knowledge. Alternatively, it might be the prime objective of the program or course that the students become concerned, effective citizens who will work toward environmental restoration and preservation. So that they will be effective, they are given instruction in the characteristics of ecosystems, of economics, and of politics. Accurate information is particularly necessary for this goal to be obtained in later years when the students can no longer have their strategies and tactics developed for them by the educator, and when the important social issues have changed. There may be some programs where the knowledge and action goals are equally dominant; but there is no necessity that this be so for a program to be an example of environmental education of the class 'education about and for the environment'. The particular emphasis has to be determined for each individual program.

EXAMPLES FROM THE LITERATURE

Introduction

Since education in the environment is a pedagogical technique, rather than a set of educational goals,the criteria for assessing the worth of proposals for this type of environmental education are clearly empirical and pragmatic: does education outside the classroom enhance students' achievement of the stated goals of the course? Are the necessary facilities and administrative support available or obtainable within the budget? By contrast, the criteria for assessing the worth of the goals of education about and/or for the environment cannot be empirical. Although it is certainly possible to determine empirically whether students have attained the goals of these programs, it is a much more difficult task to assess the worth of the goals.

The difficulty of assessing program worth is most apparent when the definitions of environmental education that exist in the literature are examined. What criteria can be used to determine which of these definitions is most apt? How can one judge whether any given definition is appropriate in a particular situation? In this section existing definitions of environmental education are examined and used as examples of each class of environmental education. The definitions examined also reveal the differences between advocates of producing specific attitudes toward particular environmental problems, and those who claim to reject the inculcation of attitudes because they are a violation of the teacher's role, particularly in a pluralistic society. The need for value judgements is demonstrated, and some questions to be answered when making these judgements are stated.

Existing Definitions and Program Goals

Selected definitions and descriptions of environmental education programs are presented in this section. No attempt has been made to be exhaustive and to record all of the variations that exist. Representative statements have been chosen to illustrate positions, and the frequency of a particular viewpoint in the current literature cannot be inferred from these examples. Empirical information concerning frequency of program types could be obtained by classifying environmental education programs on the basis of their published goals and textual materials, but knowledge of the relative frequency of each type of program in 1972 does not help us understand the essential characteristcs of, and conflict between, these classes. Tabulations of this type would be valuable if temporal trends in environmental education, regional or grade level variations, and cultural differences were being determined, but may be misleading in this analysis: a predominance of one type of program could lead us to assume that the differences between this major class and the others need not be questioned.

In this section little attention is paid to the components of environmental education programs that refer to 'education in the environment'. This is a deliberate under-emphasis, for, as indicated above, 'education in the environment' is conceptually different from education about or education for the environment. It refers to a teaching technique; the latter two are concerned with educational goals. We concentrate on the analysis of goals here, for that is fundamental: teaching techniques must be assessed in relation to educational goals, and the use of any particular technique has little effect on the conceptualization of the goals or on resolution of differences between advocates of different goals.

Examples of the Compound Classes of Environmental Education. The definition of environmental education prepared by by a seminar in the School of Natural Resources in the University of Michigan, and reported by Stapp, has been widely used, in its original form or modified by other authors. It is clearly an example of the compound class of environmental education with its emphasis on education about and for the environment:

> Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution.[15]

It is also clear from this definition that both components of education for the environment--techniques of producing change and attitudes predisposing citizens to effect change--are included. When the authors clarify their intent, by spelling out some of the major objectives consistent with this definition, they emphasize that attitudes are an important component of the characteristics of an environmentally educated citizen. They explicitly state that one of the major goals of environmental education is "to help individuals acquire . . . attitudes of concern for the quality of the biophysical environment which will motivate citizens to participate in biophysical environmental problem solving."[16]

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[15] William B. Stapp et al., Journal of Environmental Education 1(1):30-31, 1969, p. 31.

Similar direct involvement in attitude formation in environmental education programs is espoused by Hawkins and Vinton:

> Environmental education ought to be a total look at where man lives, how he lives, and finally why he lives.
>
> . . . The student should gain: 1) A broad understanding of the environment, both natural and man-made; 2) A clear understanding that man is a central and inseparable part of the complex environmental system and that he has the ability to alter the inter-relationships of the system; 3) A fundamental understanding of the environmental problems confronting man, how these problems can be solved, and the need for individual citizens and government agencies to work toward their solution; and 4) Attitudes of concern for the quality of the environment, which will motivate him to participate in environmental problem solving.
>
> The ultimate goal is for the student to develop an awareness of his environment that will lead to a personal sense of involvement and eventually to the shaping of an environmental ethic to guide his behavior.[17]

The generic relationship to the Stapp et al.definition is clear; the amplifying modifications do not alter the main thrust of the original, and it is clear that the programs envisioned by the definers would be both about the environment and for the environment, and, although not part of the definition, the article insists that they also provide direct experience in the environment. Note that this definition preserves the dual goals of the for component of the program: knowledge of how to solve problems and a predisposition to attempt problem solution.

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[16] Ibid.

[17] Donald E. Hawkins and Dennis A. Vinton, Art Education 23(7):48-52, 1970, p. 50.

Attitude development is not as clearly included in all definitions of environmental education as it is in those of Stapp et al. and Hawkins and Vinton. In the more-or-less official United States government definition no mention is made of attitudes:

> "Environmental education" means the educational process dealing with man's relationship with his natural and manmade surroundings, and includes the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, and urban and rural planning to the total human environment.[18]

This definition, standing alone, could be used as a prime example of the basic class of environmental education, 'education about the environment'. No mention is made of the preservation of the environment, of techniques of altering the environment or halting its deterioration, or of attitudes concerning the environment. The legislators' intent is seen only when the definition is read in the context of the purpose of the Act. The statement "It is the purpose of this Act to encourage and support the development of new and improved curricula to encourage understanding of policies, and support of activities, designed to enhance environmental quality and maintain ecological balance"[19] shows that Congress passed the law to provide assistance for programs for education for the environment as well as about the environment.

Despite the wording of the definition, the Environmental Education Act provides an example of a member of the combined class of programs 'education about and for the environment' where the emphasis is clearly on the for component. The legislation contains the explicit assumption that "the deterioration of the quality of the Nation's environment and of its ecological balance . . . is in part due to poor understanding of the Nation's environment and of the need for ecological balance."[20] That is, it is assumed that increasing knowledge will lead to actions that will restore, or prevent further deterioration of, the human environment in the United States. Here, then, the education *about* the environment described in the definition of environmental education is assumed to be a means of educating *for* the environment. Although there is no explicit mention of attitude formation in the text of the Act, and although there is no reference to the skills that will lead to preservation of the environment, the assumption that knowledge will lead to attitude formation, skill development, and action appears to be made. If this assumption is not made there can be no reconciliation between the stated purposes of the Act and the explicit definition.

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[18] U.S., Public Law 91-516, Sec. 3(a) (2).

[19] Ibid., Sec. 2(b).

Although there is no specific mention of education *in* the environment in the Environmental Education Act, the legislation recognizes that it is a technique that should be encouraged. The planning of outdoor environmental education reserves is one of the programs used as an example of how the funds provided by the Act can be used.[21] That possibility means that at least some of the programs supported under the Act were expected to be education *in*, *about*, and *for* the environment.

Revelle's comment on the role of education in solving environmental crises can be contrasted with the positions in the Environmental Education Act. He states that education has a threefold purpose: the production of the specialist professionals required to deal with problems; the "formulation and inculcation of moral and intellectual values upon which environmental improvement must rest;" and the creation of a "heightened sensitivity among young people" to their surroundings.[22] Taken by itself, it could be an example of goals purely for the environment, but "sensitivity" to the surroundings would almost certainly include knowledge about at least some parts of the environment with which Revelle is concerned. Many of these components are not directly observable, for they include comparisons: awareness of "the depletion of natural resources" and the "proliferation of noxious wastes" requires knowledge of pristine conditions or some base data, and sensitivity to the "depletion of natural resources" depends upon knowledge of mining and industrial techniques and of what happens to discarded materials and domestic wastes.

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[20] Ibid., Sec. 2(a).

[21] Ibid., Sec. 3(b) (2) (E).

Revelle's statements concerning the role of education and the definition of environmental education in the Environmental Education Act are complementary. Revelle appears to advocate education for the environment, but the context indicates that some education about the environment is implied. As it stands, the Environmental Education Act definition is almost purely about the environment, but the context shows a clear intent to include education for the environment. In reality, both are examples of the class of environmental education that is both for and about the environment. These two examples illustrate the importance of examining definitions and statements in context when there is no explicit statement of which of the seven possible classes of environmental education is intended.

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[22] Roger Revelle, New York Times, January 12, 1970, p. 75.

Some authors specifically propose that environmental education be considered as education in and for the environment, de-emphasizing education about the environment. Ames states that schools "must teach through the environment as a source of learning experiences rather than about the environment as a generalized object of study . . . in the final analysis the success of environmental education will be measured in terms of its ability to change the behavior of society."[23] The behavior should be changed "in order to moderate society's impact on the environment."[24] The tenor of the paper suggests that Ames feels that education about the environment is of limited value. He feels that "ecology as curriculum content is primarily useful in that it relates a great deal of diverse information about the environment and its processes." He does not question "the importance of environmental learning in this sense, but it must remain a relatively distinct part of the curriculum."[25] He suggests that unless the immediate, out-of-class environment of the child is used as the vehicle through which a complete education is provided, education about the environment will be sterile and not achieve the goal of changing societal actions.

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[23] Edward A. Ames, in Outlines of Environmental Education, ed. Clay Schoenfeld (Madison, Wisconsin: Dembar Educational Research Services, 1971), p. 94. (Emphasis in original).

[24] Ibid.

[25] Ibid., p. 93.

Examples of Basic Classes of Environmental Education. Descriptions of and prescriptions for programs intended mainly as education for the environment are relatively common in the literature. Some articles describe programs intended to encourage students not to litter; others attempt to produce an attitude favorable to population control; and others advocate the production of a "biotic ethic."[26] There is a large component of attitude manipulation in many of these programs, with the instructional techniques designed to have a large emotional impact. For example, a colony of beetles set up to simulate population growth was intentionally arranged so that students would become concerned about population growth. Although data on population increases were provided, the whole exhibit was aimed at producing an attitude favorable to population stabilization.[27]

Public education programs of some "ecology action groups" and "environmental organizations" are often very clear examples of education for the environment, with a strong emphasis on attitude change and the eradication of what are thought to be "ecologically unsound" habits.

"Don't use leaded gasoline," "Use low phosphate detergents," "Eat organically grown food," and "Ban all pesticides" or similar slogans are used in attempts to change people's attitudes toward certain practices and influence their behavior.[28] Clearly these are not examples of education about the environment, or at least, not adequate education about the environment. The reduction of lead in gasolines is achieved by the addition of hydrocarbons which, when burnt in the engine, increase the output of 3,4 benzpyrene, a potent carcinogen.[29] Unthinking use of low-phosphate detergents can also have unwanted side-effects: some of these detergents reduced the phosphate content by substituting a nitrogen based compound, NTA, since removed from use, which would also contribute to excessive fertilization of receiving waters; others used extremely high concentrations of alkalis which caused dermatitis in susceptible users.[30]

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[26] Irvin T. Edgar, The Science Teacher 38(4):45-47, 1971; Betty Jane Meadows, American Biology Teacher 32:281-283, 1970; J. George Harrar, in Outlines of Environmental Education, pp. 63-64.

[27] David H. Milne, American Biology Teacher 31:97-101, 1969.

Blanket bans on fertilizer and pesticides, emotionally advocated by some of the public education groups, are also likely to be inadequately considered from the point of view of unbiased education about the environment; there almost certainly will be adverse effects on the well-being of individuals if all use of "synthetic" fertilizers and pesticides is prohibited. Public health authorities would lose valuable weapons, and the social effects of possible reduced agricultural production in some areas of the world could be great. A more reasonable stance would be to advocate application of pesticide and fertilizer only after a complete analysis of the costs and benefits of both courses of action--applying and withholding them--in each particular case. (Economic, social, and health factors are among the costs and benefits that should be considered).

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[28] See Garrett de Bell, ed., The Environmental Handbook (New York: Ballantine, 1970), for some examples of these viewpoints, especially pp. 300-306. (Note that not all included articles take this activist position: many advocate a careful, rational approach). Other examples of the slogan-based campaigns include student groups active in promoting recycling of glass, including action to initiate local legislation to ban use of non-returnable bottles in Worthington, Ohio; use of low-phosphate detergents; and establishment of "Waste Watchers Centers" to recycle glass, cans, and paper. Other "hints" for so-called ecological living can be found in Dirck Van Sickle, The Ecological Citizen: Good Earthkeeping in America (New York: Harper and Row, Perennial Library, 1971).

[29] This example is discussed more fully in Chapter VI, where appropriate references are given.

[30] Allen L. Hammond, Science 172:361-363, 1971.

Advocates of simplistic attitude changes would count their educational program a success if the members of the public accepted the attitudes implied in their slogans. It would probably not matter to them whether these attitudes were adopted on the basis of a thorough examination of the consequences of the alternative behaviors substituted for those deemed "ecologically bad." The end result, and not the reason for holding the attitude, is of prime importance to these groups. These activist programs are extreme examples of education for the environment, which, perhaps because their proponents ignore much data about the environment, may not assist in achieving the ultimate goal of the activists--a life that does not disrupt the ecological cycles upon this planet.

Authors whose positions on environmental education imply programs with characteristics resembling the class 'education about the environment' often reject some of the features of 'education for the environment', whether in a combined program or a program oriented toward a single goal. Statements of two of these authors will be used here to illustrate the arguments used.

Ivany is specifically writing of the role of science teachers in environmental education, and his position demonstrated in this instance may not extend to environmental education programs that are based on other disciplines, or the non-science components of a multi-disciplinary program. However, he argues consistently for "reason and the intellectual pursuit of understanding the environment" and against what seems to him to be the more popular approach "through immediate action under such glamorous titles as 'ecotactics' or 'environmental action'."[31] According to Ivany, "the most alarming aspect of the educational problem is the apparent inability of our teaching to create among students an intellectual posture towards environmental difficulties . . . Increasingly, it seems, our students are denying that /rational-empirical approaches to problem solving_7 are feasible."[32]

In his reaction to O'Neill's paper that recommends that Australian schools become involved in "actively promoting the restoration and preservation of the quality of our total human environment,"[33] Morgan argues that in a society that values independently thinking adults it is "improper for a teacher to set out to develop a particular attitude in his students to a particular social question."[34] (Environmental issues are included among drugs, war, racism, and censorship as examples of social questions). Elsewhere Morgan supplements this ethical objection to the inculcation of particular attitudes by a pragmatic objection: "there will be many social questions of the future which we cannot yet foresee, but which students [illegible] have to face."[35] Therefore, we will fail in our task of preparing [illegible] to face their futures if we only provide ready-made attitudes to present problems.

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[31] J.W. George Ivany, in Environment: Readings for Teachers, ed. J.W. George Ivany (Reading, Massachusetts: Addison-Wesley, 1972, p. 4.

[32] Ibid., p. 6.

[33] Beverley O'Neill, in Education and the Environmental Crisis, ed. Jeremy Evans and Stephen Boyden (Canberra: Australian Academy of Science, 1970), p. 48.

[34] David G. Morgan, in Education and the Environmental Crisis, p. 50.

Morgan's position suggests that he would agree with Ivany's comment that "ways can be found to support and encourage action and personal involvement without jeopardizing the stance of responsible science teaching."[36] Both are concerned with the preparation of citizens who value rational thought: "citizens who are ready and capable of tackling all social issues responsibly and capably--as citizens--wherever and whenever they occur."[37] Both authors do have, therefore, some overtones of education for the environment in their positions, but their basic thrust is rational education about the environment.

Ivany is closer to advocating 'education for and about the environment' than Morgan, who notes that "information on man's effects on his surroundings merits inclusion in school programmes simply because it is part of man's culture."[38] Ivany is perhaps more inclined to advocate a position that implies that education about the environment is a prerequisite for effective solution of the problems of the environment.[39]

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[35] David G. Morgan, in "Biological Education in Australian Secondary Schools," ed. A.M. Lucas (Duplicated report presented to the Australian Academy of Science, 1970), p. 93.

[36] Environment: Readings for Teachers, p. 4.

[37] Education and the Environmental Crisis, p. 50.

[38] Ibid.

The dispute over the use of educational systems to inculcate specific attitudes and produce certain types of "ecologically sound" behavior is potentially the most important difference between environmental educators. The other differences may become acrimonious, but it is relatively unimportant whether the instruction in environmental education programs be conducted _in_ the environment; in any case, it is a question that can be settled by empirical experiment. If the goals of the program are achieved more effectively or efficiently out of the classroom, then there are grounds for advocating teaching in the environment around the school. The question of including deliberate attempts to produce an attitude change in a direction thought desirable by the teacher, school system, or curriculum developer is not so easily settled. This question will be examined in more detail in the next chapter.

Referent and Components of 'Environment'. There is as much diversity in the referent of 'environment', and in the components of the environment of the referent considered relevant in discussions of 'environmental education', as there is in discussions of 'environmental deterioration' or 'environmental problems'. Some discussions are mainly concerned with the environment of the species,[40] some with the environment of the population of the United States,[41] and others with the environment of the individual.[42] Some programs include 'other people' as part of the environment;[43] others include only the more-or-less natural biophysical environment;[44] but some include human artifacts as part of the environment with which they are concerned.[45]

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[39] _Environment: Readings for Teachers_, p. 4: "Appropriate ecological education demands prior knowledge of interactions in the biosphere."

[40] _Environment: Readings for Teachers_, p. 3: "man's present methods of interaction with his ecosphere cannot be continued indefinitely without suicidal consequences" is clearly refering to the species as a whole.

All these variations of referent and of components of the total environment considered relevant are logically sensible, and all can count as positive instances of 'environmental education'. We saw in Chapters II and IV that the appropriateness of the particular referent chosen, and the components of the total environment considered relevant, are a function of the purpose of the investigator. Similarly, in environmental education, the adequacy of a program can only be judged in relation to the purpose of conducting environmental education. Thus the choice of program depends upon an analysis of the purpose. This choice, and methods of comparing different purposes for environmental education, are examined in the next chapter.

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[41] Public Law 91-516, Sec. 2(a): "deterioration of the . . . environment and of its ecological balance poses a serious threat to the strength and vitality of the Nation."

[42] For example, the Wave Hill Center for Environmental Studies considers 'environment' to refer to the "totality of all the external conditions and influences affecting the development of the individual," (undated descriptive brochure distributed by the Wave Hill Center). A description of the Wave Hill program can be found in A Review of Environmental Education for School Administrators, p. 51.

[43] In the Wave Hill program 'environment' includes the teacher and other children within the classroom, (Wave Hill Center for Environmental Studies, undated duplicated paper: "Meaning of the word 'ENVIRONMENT' in the title: Urban Environmental Education Program," p. 3). See also A Review of Environmental Education for School Administrators for descriptions of other programs that include 'other people' as part of the environment: "Americans in Cities," (p. 128) is designed to give information about the social and cultural environment of individuals; Harvard University Social Studies Project materials consider political science and ethics, (p. 103). (The latter project appears to have been included in the review because of its consideration of skills needed to effect environmental change, rather than as an example of education about the environment).

[44] The Conservation and Outdoor Education Program of the Ann Arbor Public Schools "stresses the study of community natural resources under natural conditions." Ibid., p.38.

[45] The National Environmental Study area program of the National Parks Service includes sites that are primarily cultural and historic in addition to those that preserve samples of "original" biotic communities. Ibid., p. 48.

Summary

'Environmental education' may refer to any one of, or any combination of, education about, for (the preservation of), or in the environment. The first two primary classes are distinguished by their goals: education about the environment aims at producing a knowledgeable individual; education for the environment is intended to enhance or maintain the environment of the entity, usually human, being considered. Education in the environment, by contrast, is a description of a pedagogic technique. In most cases where environmental education refers to 'education in the environment', 'environment' is intended to mean "outside the classroom."

Education for the environment entails producing persons with the technical or social skills necessary to achieve the goal of the program. Although it is not a necessary distinguishing feature of programs for the environment, many discussions and examples of this class stress the inculcation of attitudes favorable to the preservation and enhancement of environmental quality. It is the emphasis on attitude formation that leads to some disagreements concerning the propriety of attempting to educate for the environment.

In many cases the definitions of environmental education given in the literature are inadequate and misleading. It is necessary to examine them in the context of the program described to determine what class of environmental education is intended. Unless the intended class is known some incorrect assessments of the programs could be made.

Existing environmental education programs consider a range of different components of the total environment of the entity used as the referent of 'environment'. The referent used also varies, some using the individual human, others the population of the United States, and some consider the environment of the human species. Most existing programs are intended to be for the environment. Although many have combined goals, for and about the environment, the for goal predominates.

CHAPTER VI

CHOOSING AN ENVIRONMENTAL EDUCATION PROGRAM

Choices between environmental education programs must be made on the basis of value judgements. That is, the choice cannot be made at random, nor is it completely arbitrary. As Green indicates, judgements, as distinct from mere guesses, "are always objective in the sense that they rest upon reasons, grounds, rules, or principles."[1] However, the grounds of judgement are not absolute or conclusive, and reasonable men may differ in their judgement. We are, therefore, unable to provide any techniques that will ensure that all people choose the same program when deciding among a set of competing programs. We can, however, provide guidance on the issues that must be faced when making the decision to develop or implement an environmental education program, and exemplify the type of argument that may be used to justify the final choice.

It is important to note in connection with the status of value judgements that there may be disagreements between alternate positions without formal contradiction. That is, except in the case of internal inconsistencies, it is impossible to use a method of contradiction to

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[1] Thomas F. Green, The Activities of Teaching (New York: McGraw-Hill, 1971), p. 178.

"disprove" a position about the goals of education, 'environmental education' or any other type. Argument over the appropriateness of the goals can proceed by using emotive language to convince one's opponent of the worth of the case, or by calling attention "to certain facts that one supposes him to have overlooked."[2] These additional facts, one hopes, will lead the opponent to see the undesirable consequences of his position and the worth of one's own. The argument will be settled if, given a set of facts which are not disputed, and prior agreement on criteria, one party sees that his position leads to consequences at variance with his real intent, and concedes that the alternate position is more appropriate. If, however, the agreed facts do not lead one party to concede that his position is really untenable, the parties must continue to disagree, for there is no sense in asking which of the conflicting values is true.

Many of the issues that must be faced when judging environmental education programs have been implied in previous chapters. In this chapter they will be discussed explicitly, examining some of the evidence relating to each, and a choice made in each instance. The final set of criteria that I choose to use to judge an environmental education program will be by no means the only possible choice. I may be attacked by challenges based on a number of grounds: I may have been mistaken in the interpretation of empirical evidence; I may have made a choice based on an ethical system different from the readers, and evidence that my system leads to an untenable position could induce me to change my choice: or I may not have forseen the implications of a set of empirically correct data taken together. But it would be inappropriate to propose an empirical experiment to falsify my value judgement; if it is truly a value judgement there is no way in which this can be done.

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[2] Alfred Jules Ayer, Language, Truth and Logic (1946. Reprint. New York:Dover Publications, 1952), p. 22.

The discussion in this chapter is intended to serve two purposes. First, it presents my choices concerning the issues that must be considered in discussing environmental education: the purpose of environmental education; the referent for 'environment' that is used; the components of the environment of the entity used as referent that are relevant for the chosen purpose; and the class of environmental program that is to be developed. Second, it is intended to illustrate a method of approach that could be used by persons who might not make the same value choices.

The implications of the position derived in this chapter will be more fully demonstrated in the following chapters; in this chapter only immediate reasons for the choices are given.

Purpose and Referent

As shown in Chapter II, the fundamental decision that must be made is determined by the purpose of considering the environment; unless this is clear there is no basis for choice of referent or for the assessment of the relevance of any component of the environment of the entity used. The reasons for our consideration of the well-being of individuals in making environmental decisions were given in Chapter III. The case will not be re-argued here, merely summarized for the sake of continuity in the following discussion.

I chose the well-being of the individual instead of the continuity of the species or the power of the nation, for the latter two positions can be used to justify tyrannical oppression or genocide. This can, and does, lead to denial of individual freedoms because of the diversion of economic and other resources to the ends of group superiority. At present, the move to defend the power of the nation-state can lead to situations where actions can lead to group, perhaps species, extermination--by nuclear catastrophe, for example. This would of course eliminate all chance of individual well-being as well.[3]

The defense against the argument that concentrating on the well-being of the individual is akin to advocating anarchy is given earlier: well-being requires consideration of the well-being of others, for co-operative efforts are needed. The argument that the position is Utopian, thus an unobtainable ideal, and therefore not worth pursuing, was also rejected earlier.

Relevant Environmental Components

When considering the well-being of the individual, all parts of the Universe other than the individual that have a potential effect on his well-being are relevant. As used in earlier chapters, "well-being" includes at least physical health. In addition, however, aesthetic satisfactions and freedom from acute psychological stress are components of "well-being." They are useful concepts upon which attention can be focussed, although they are not necessarily distinct from physical health.[4] Given this purpose and extended definition of well-being we can briefly examine the major groupings within the Universe external to the individual, and determine whether they are relevant components of the environment for our purposes.

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[3] Bertrand Russell, Has Man a Future? (Harmondsworth, Middlesex: Penguin, 1961).

One useful classification of the parts of the Universe external to the individual considers three broad classes: the abiotic components; other species (biotic components); and conspecifics (socio-cultural components).

Abiotic. It is clear that at least some of the abiotic components of the Universe have a marked effect on physical health. Caves or other non-living materials such as sandstone blocks can be used to provide shelter from the extremes of climate, which are another manifestation of the abiotic environment. Electromagnetic radiation interacts directly with the individual, assisting in his synthesis of vitamin D, perhaps causing radiation sickness, acting as a carcinogen, and providing sensory stimulation via the retina.

Aesthetically, the form of the earth's crust can provide psychological satisfaction, as can the interaction of light rays with clouds and raindrops.

There can be little argument that at least some abiotic components of the total environment of the individual are relevant.

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[4] Some of the factors labelled 'psychological', rather than 'physiological', may be a function of ignorance. Perhaps additional physiological data will explain some phenomena now called 'psychological'. The distinction made here is not intended to imply that there is necessarily a dichotomy between physiological and psychological factors.

Biotic. There is no doubt that some parts of the biotic environment, other than other humans, are relevant components of an individual's environment when we are considering his well-being. Other organisms contribute to his nutrition, e.g., food-plants and animal protein sources; his shelter, e.g., natural fibres; and, in some cases, his psychic satisfaction, e.g., yeasts (fermented beverages). Other organisms can also affect him adversely, by causing disease or competing with him for food resources, e.g., tuberculosis bacilli and corn-stem borer, respectively.

Socio-cultural. Evidence that other people are not normally spoken of as part of the environment was presented in Chapter IV. For our purposes, however, they are relevant components of the environment of an individual. They can adversely affect physiological well-being under some circumstances, and it is essential that some other person care for infants for at least part of their lives.

The personal satisfactions obtained by contact with other members of the species are also reasons for considering socio-cultural components of the total environment. The opportunity to participate in sport, musical and theatrical productions, or conversations contributes to a person's well-being.

For our purposes, then, we are interested in a larger set of the components of the literal environment than are included in the environment. But because of this extension it is important that the components being considered be carefully specified so that this usage will not be confused with the common implicit meaning of the environment.

Priorities Among Environmental Components. The factors that affect the well-being of an individual are included in the abiotic, biotic, and socio-cultural components of his literal environment. However, not all of the components of each part of the total environment are equally important. This poses problems in environmental education for it is necessary to select the subject matter to be used in courses, whatever class of environmental education program is selected. The educator needs some method of selecting the factors that he will include.

Some selection criteria depend upon the interests of the students, as well as their setting. Descriptions of the ecology of the African elephant in the Tsavo National Park are probably of less importance to a resident of Coonabarabran, Australia, than a consideration of the kangaroo/sheep/native-pasture system of the local plains. But both these examples may be relevant when considering the general principles of population dynamics and competition in a Cleveland, Ohio, classroom following an examination of the ecological relationships in Lake Erie.

In addition, considerations of intrinsic importance to the well-being of the individual can help determine the factors to be included. Something that is likely to have a drastic effect on the individual is clearly more important than something that might affect him slightly if he ever comes into contact with it. This is a particularly important consideration if the knowledgeable individual can facilitate interaction with a favorable environmental component, or avoid a deleterious effect. If we apply this criterion to environmental education in the United States, we find that more emphasis should be given to syphilis and hepatitis than to sleeping sickness or trypanosomiasis when considering public health.

If we apply the same criterion to the abiotic component of the environment of an individual, we have to consider the effects of such things as energy supply, the use of land, and the supply of minerals. It then becomes difficult to rate the relative importance of an energy supply and a source of steel, for example. The two types of necessity are not apparently measurable using the same comparative units. As in this particular example, both things are likely to be interconnected, and it appears a futile exercise to unravel them and decide which is more fundamental.[5]

If, however, we examine the problem of ranking priorities by considering specific aspects of well-being we can begin to establish the contribution of the various relevant components of the environment. Consider the well-being of one individual. If he is to be in a state of well-being his life must not be threatened, he must be psychologically healthy, free of serious disease, able to make any contacts that he desires with other people and with organisms of other species, and he must be able to co-operate with his fellows to minimize conflict and maximize mutual support.[6]

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[5] There have been attempts to develop common scaling techniques to allow numerical estimates of total environmental impact of a proposed project, and to determine the relative importance of particular components of proposed actions. A Battelle study developed an Environmental Evaluation System for water resource planning, /Norbert Dee et al., "Final Report on Environmental Evaluation System for Water Resource Planning to Bureau of Reclamation, U.S. Department of the Interior. Contract No. 14-06-D-7182," (Columbus, Ohio: Batelle Columbus Laboratories, 1972)./ Use of the system results in a score in Environmental Impact Units 'with' and 'without' the proposed project. The Environmental Impact scores are based upon multiplication of parameter importance and environmental quality. The Batelle group identified 78 parameters, assigned relative parameter importance units on the basis of several individuals' subjective value judgements that are treated by a technique that "is systematic in nature, minimizes individual bias, produces consistent comparisons, / and/ aids in the convergence of judgement," (p. 103), and provided criteria for converting measurements of the parameters to an equivalent environmental quality scale. Results of a test of the proposed system are included in the report.

We can attempt to rank these conditions needed for well-being by asking "Is there any condition which, if not met, would clearly and unambiguously result in an adverse situation, regardless of the satisfaction of the other requirements?" Taking the extreme condition can help focus the situation, so we ask specifically "which of these states must be satisfied for the person to continue to live?" Then we can examine the factors in each of the abiotic, biotic, and socio-cultural components of the total environment.

Clearly the individual will die if deprived of a source of cellular energy. This supply depends upon three basic factors: food, oxygen, and a functional enzyme system. In ranking environmental components in terms of their importance to an individual's well-being their effects on these three factors need to be considered. We have seen in Chapter IV that there need not be concern about the continued world-wide supply of oxygen, so this factor can be relegated to a lower position on a list of important parameters presently threatening well-being. But there are threats to the supply of food, and the addition of new chemicals to the individual's environment may interfere with the cellular mechanisms that supply his energy.

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[6] Although this statement appears to be an assertion of facts, it should be realized that there are strong value components present. For example, "psychologically healthy" may not be easily measured, for the conditions for psychological health could conceivably differ for persons with different value systems. There are also strong value overtones in the notion that one of the components of well-being is the freedom to make contact with other organisms and other people, and the requirement that co-operation is necessary.

Food supply is affected in two basic ways. Firstly, the absolute supply of food being produced on Earth each year. There are a number of factors that are known to affect this parameter. The increasing use of arable land for building and transport space in the developed countries, the denudation of land through faulty agricultural practices, including salinization of irrigation land, laterization of exposed tropical forest soils, the decreasing fertility of overcropped soils, and the increased chances of crop loss by pandemics of plant pathogens in genetically homogeneous monocultures are examples. Some of these factors are being counterbalanced: for example the addition of artificially produced fertilizers such as ammonia can restore some of the soil nitrogen removed by cropping, and the contribution of the plant breeders who introduced high yielding, disease resistant grains has led to the so-called Green Revolution. These positive influences also need to be examined in a balanced environmental education program, as does a consideration of the side-effects of these changes alluded to in earlier chapters.

Secondly, effective food supply is affected by the available food per capita. Clearly, the number of people who have to share the total human food production affects the supply available to any one person. But so do other factors that may not be dependent on the size of the human population. Political and economic considerations govern the supply of food in world trade. United States and Australian farmers have in the past been regulated by governments who have used various devices to keep arable land out of production when it was considered uneconomical to produce to maximum capacity. These policies were in force at times when there were shortages of food in some regions of the world, but the "needy" countries were not in a position to pay for the grain.

As well as global inequalities, personal experience shows us that not all people in a nominally affluent country are equally well fed: some individuals may be short of food, or unable to obtain a balanced diet even if they are not absolutely short of food. Various economic and social reasons may be involved, but they need not be elaborated here.

When considering food supply, it is, therefore, necessary to include agricultural practices, energy supply for food distribution and production,[7] social and cultural arrangements, as well as the nutritional composition of the food. In countries where most of the food supply is "processed" and has numerous additives for preservation, ease of manufacture and increased attractive shelf life, it is also necessary to examine the health effects of these additives and political considerations such as the "Delaney ammendment" to the United States food and drug laws.[8]

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[7] John E. Ross, in a working paper circulated privately, reports that "we are using at least one calorie of fossil fuel to place one calorie of food on the American table."

[8] The "Delaney Ammendment" to the U.S. Food, Drug, and Cosmetic Act states "That no additive shall be deemed safe it is found to induce cancer when ingested by man or animal, or if it is found, after tests which are appropriate for the evaluation of the safety of food additives, to induce cancer in man or animal." The debate over the implications of the law, and over the interpretation of "tests which are appropriate" is clearly political, as well as technical. A recent summary of

Similarly, when we are considering the effect of environmental factors on a healthy, intact enzyme system, we need to examine the effects of pathogenic micro-organisms on cellular function, and the possibility of enzyme poisoning by toxins from the environment. Lead from paints in older buildings can have an effect on children, and it is important that the cause of the resulting "disease" be treated directly, rather than by the "ludicrous attempt of the medical profession to leach the lead from peeling paint by using the human body as a carrier. Our FDA-approved chelating agents do not work on walls; we therefore allow children to eat the paint so that we can remove the lead from the children's circulation, where our wonder drugs work so well."[9] This satirical comment makes the point very well: we must examine the environmental origin of the causative agent, and treat that, not just the symptoms.

We have seen from this brief sketch that when considering the necessity for a continued supply of metabolic energy at least the following factors must be included:

Oxygen availability--

Although oxygen may become effectively absent from the tissues in the course of some toxic episode, for example carbon monoxide poisoning, there is no reason to fear that a general

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the disputes between scientists in different public agencies, and those not employed by government, can be found in Nicholas Wade, Science 177: 588-591, 1972.

[9] Frank R. Freemon, Perspectives in Biology and Medicine 15:311-312, 1972, p. 312.

shortage of oxygen will occur.[10]

Disease--

Since pathogenic organisms interfere with cellular metabolism, public health and waste disposal practices are relevant. Abiotic toxins, for example those in air, water, and food, should also be included in any complete discussion.

Food supply--

Factors facilitating agricultural productivity, the sources of energy for food production and distribution, and the socio-political arrangements that influence food supply per capita are all relevant variables. The adverse effects of some of the factors enhancing food supply on other parameters of well-being must also be taken into account, for instance, the dangers of increased concentrations of fertilizer ions in drinking water obtained from run-off from agricultural areas must be included when weighing the benefits of agricultural practices.[11]

This one function--cellular energy supply--includes many of the environmental problems that are being considered in isolation by many authors. Population size, food supply, waste disposal, effects of industrial wastes that may contaminate food, the supply of energy for food production and distribution, and social and political systems affecting distribution of food, are all included as part of a system centering on the most fundamental parameter of well-being.

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[10] See Chapter IV, footnote 9.

[11] The example of food supply is treated more fully in Chapter VIII, where it is used to illustrate the form that a curriculum based on the principles developed in this chapter may take.

The relative importance of each of the factors affecting physiological health could, if necessary, be determined in the same way: food supply is more important than an adequately balanced diet, for without any food the individual must very soon die; with a deficient diet he can survive, albeit under some stress. The presence of low level carcinogens in food is of less absolute importance than the possibility of botulism, for the latter is almost certainly going to be fatal, while low levels of cyclamates may produce a slightly greater chance of death from cancer at a relatively long time in the future. The particular factor of greatest concern will also vary with the location and degree of development of the society: in the United States the danger from carcinogens in food may in fact be greater than the risk of eating food contaminated with *Bacillus botulinus*. But in a less industrialized country the risk of death from parasitosis may be greater than the danger from either botulism or carcinogens added to food.

Similar analysis could be made for psychological well-being. As indicated in Chapter IV both abiotic and living portions of the total environment affect a person's psychological health. *Environment and the Social Sciences: Perspectives and Applications* contains data on the factors that affect satisfaction with housing areas, recreation facilities, and architectural and administrative arrangements of institutions.[12] The papers in this collection, and the references they cite, can be used as starting points to analyze systems centered on the psychological well-being of individuals.

As well as minimum requirements for physiological and psychological well-being, the effects of environmental variables on parameters that add to well-being, but which are not absolutely essential, may be considered. Such factors as the supply of personal transport come into this category. If an individual's desire for transport more-or-less continually available is to be satisfied, there are a number of factors that must be present in his environment. He must have a vehicle at his disposal, although not necessarily own it privately; there must be fuel available for the vehicle; and some sort of right-of-way over which it can move. The exact nature of the fuel and of the right-of-way will depend upon the type of vehicle actually used. The costs and benefits of alternate types of vehicle, ranging from private car to a dial-a-bus public transport system, can be calculated if all necessary data are known. Analysis of the costs of each alternate method of meeting the "need" must include an examination of the effects each has on the prime requirements for well-being. For example, the effect of exhaust gases from an internal combustion engine on enzyme systems needs to be compared with the chances of sickness caused by wastes from power stations that would be necessary for charging batteries of electrically operated vehicles.

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[12] Joachim F. Wohlwill and Daniel H. Carson, ed., Environment and the Social Sciences: Perspectives and Applications (Washington, D.C.: American Psychological Association, 1972).

The emphasis on the function desired, in this case personal transport, should lead to a more adequate analysis of the relevant components of the environment than a simple consideration of the costs incurred when a private car is manufactured, used, and disposed of. It avoids limiting discussion to present methods of achieving the desired end.

Similar analyses could be made of other components of the well-being of an individual, and finally, a list of functions that should be fulfilled would be produced. It is this list, rather than a list of environmental parameters such as water, air, "pollution," fuel supplies, and mineral resources, that should form the basis of an environmental education program.

Basing consideration of environmental variables on the criterion of well-being, rather than on the environmental variables themselves, has a number of advantages. It focuses attention on the relevant parameters of the environmental variable, ensures that they are not considered in isolation, and facilitates the recognition of gaps in our knowledge. Specific examples of the effects of some environmental variables on well-being are given in Chapter VIII.

Class of Environmental Education Program

My purpose for considering 'environment' means that the goal of any "environmental" program I design should be the enhancement of the environment to facilitate individual well-being. This is clearly an example of 'education *for* the environment'. Thus, according to the analysis in the previous chapter, my objectives must include the production of the appropriate interactive skills. The production of specific attitudes is also a possible goal of such a program, but the propriety of inculcating attitudes must be considered. In addition, I must decide whether the program developed should have any characteristics of 'education about the environment' and 'education in the environment'; that is, whether the program will be an example of the combined class of environmental education.

The justification for including 'education about the environment' and 'education in the environment' as part of the program must be empirical. If there is evidence that persons who are knowledgeable about the effects of environmental parameters on individual well-being can facilitate their own well-being and/or that of others, then education about the environment should be a feature of the program. Similarly, if personal experience of environmental influences is advantageous in achieving the goals of the program, then the teaching technique, 'education in the environment', should be used.

Identification of the assumptions concerning the relationships of knowledge, attitudes, and actions, made by environmental educators, can help guide the empirical questions that must be answered when making judgements concerning environmental education programs. Identification of the assumed causal links can specify the types of data needed, and, if any set of assumptions is shown to be untenable, then environmental education programs based on them should not be adopted or emulated.

Sometimes these assumptions take the form of a sequential model of the relationship between knowledge and actions. Southern, for example, explicitly proposes "that if the child acquires particular broad environmental understandings (knowledge) he will develop a social conscience (attitudes) that will affect his behavior (actions) toward the total environment."[13] She offers no evidence to support this belief. If she is correct, there would be no need to attempt to change attitudes or provide stimulus for action; producing knowledgeable citizens would be the only concern for environmental educators. Her position is summarized in Figure 1.

Figure 1

KNOWLEDGE* ⟶ ATTITUDES ⟶ ACTIONS

Schematic representation of the assumptions underlying Southern's conception of environmental education. The position of educational intervention is indicated by the asterisk.

Other authors rarely state their assumptions concerning the relationships between attitudes, knowledge, and behavior as explicitly as Southern. The University of Michigan definition discussed in Chapter V clearly assumes that there is a relationship between knowledge (both knowledge 'that' and knowledge 'how') and action, and between action and attitudes. While it is possible to interpret the definition in terms of a linear model similar to Figure 1, with educational intervention directed at both knowledge and attitudes, a more reasonable interpretation is given in Figure 2. That is, the definition and discussion offered by Stapp et al. implies that educational intervention should occur at the knowledge 'that' level ("knowledgeable concerning the biophysical environment"), the knowledge 'how' level ("aware of how to solve these [environmental] problems"), and the attitude level ("motivated to work toward [environmental problem] solution").

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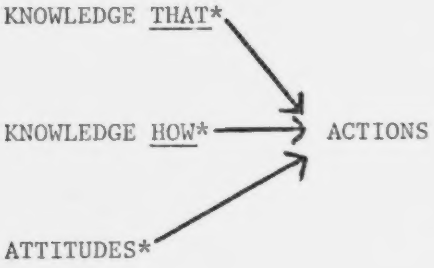
[13] Beverly H. Southern, in Outlines of Environmental Education, ed. Clay Schoenfeld (Madison, Wisconsin: Dembar Educational Research Services, 1971), p. 57. (Southern's parentheses).

Figure 2



Schematic representation of the assumptions underlying the Stapp et al. conception of environmental education. The positions of educational intervention are indicated by the asterisks.

A cyclic model similar to that shown in Figure 3 appears to underly the activities of other groups. Here it is expected that activities such as collecting litter from a roadside, or participating in the detailed study of a water pollution situation to provide evidence for political lobbying[14] will influence attitudes and increase knowledge (usually, but not necessarily, both knowledge 'that' and knowledge 'how'). The changed attitudes and increased knowledge are then assumed to generate new activities, directed toward related goals, or more effective versions of the original actions.

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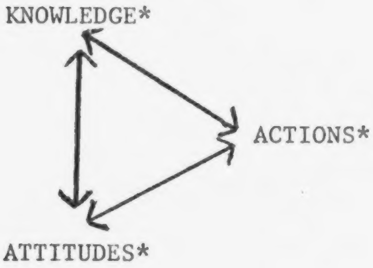
[14] Irvin T. Edgar, The Science Teacher 38(4):45-47, 1972; John T. Hershey et al., A Curriculum Activities Guide to Water Pollution and Environmental Studies (Cleveland Heights, Ohio: Institute for Environmental Education, 1971).

Figure 3



Schematic representation of an alternate model relating attitudes, knowledge (both knowledge 'that' and knowledge 'how'), and action in environmental education. Asterisks indicate sites of educational intervention.

In the sources cited there is an implicit assumption that knowledge leads to attitude formation, e.g., "when the litter from a few blocks is placed in a pile, the results are impressive, and the message concerning an individual's contribution to litter control in his own community is inescapable,"[15] but there is no explicit evidence that the writers assume that attitude formation inevitably leads to knowledge generation. However, the description of the Germantown Academy students turning to the collection of empirical data concerning industrial and community pollution of water supplies to support their lobby of the Pennsylvania legislature suggests that the knowledge was generated in response to an attitude of concern.[16] The nature of the curriculum materials produced by the Tilton water pollution program implies that this relationship is expected to recur.[17]

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[15] Irvin T. Edgar, *The Science Teacher* 38(4):45-47, 1972, p.46.

Educational intervention in this cyclic model is primarily at the action level, providing opportunity for the student to participate in some action that enhances the environment (for example, collecting trash, attempting to influence legislation), but educational materials may be supplied to facilitate knowledge generation, and educators may attempt to produce particular attitude changes. For this reason each level of the model is indicated as being amenable to, and appropriate for, educational intervention.

These models have some features in common. They all are directed toward the goal of environmental action. But they have been proposed here in terms of an educational program that is essentially 'education _for_ (the preservation of) an environment' that will enhance well-being. It is conceivable that other models could be proposed if the environmental education program being advocated was a member of the class 'education _about_ the environment', in which case the desired end-point would be a knowledgeable individual. It is not suggested, therefore, that these three models exhaust all possible sets of assumptions relating environmental attitudes, knowledge, and actions.

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[16] _Curriculum Activities Guide to Water Pollution_, p. xvii.

[17] The materials produced by the Tilton School Water Pollution Program, published as the _Curriculum Activities Guide to Water Pollution_ cited above, are designed to enable the teacher to "'run with' the particular interests of his or her students as they already exist," (p. xvii), and to capitalize on the "desire on the part of students today to be directly involved in their society," (p. xiii).

Each of the models also shows a causal link between attitudes and actions. Unlike the previous feature in common, this is not merely an artifact of the type of program being advocated; the link is explicitly assumed to exist by the authors cited, and reflects the usual use of "attitude" by environmental educators. The other link, between attitudes and knowledge, is not common to all three models, being absent in the representation of the Stapp *et al.* position, (Figure 2).

Knowledge and Actions. In Chapter V it was shown that one necessary prerequisite for effective actions leading to the preservation of the environment was knowledge of how to affect the environmental parameters. Similarly, it is necessary to know that certain phenomena exist before they can be consciously affected. But this does not mean that actions will *necessarily* follow from knowledge. Indeed, one complaint about school programs is that students are given the knowledge, but not encouraged to act.

The failure of action to follow knowledge is adequately demonstrated in a number of instances of individual or corporate behavior. Knowing that a stream is being contaminated by wastes from a mine does not mean that the wastes are diverted or the process changed; knowing that paper mill wastes increase the biochemical oxygen demand does not result in installation of plants to treat the waste; knowing that some insecticides can be absorbed through the skin does not result in the wearing of protective clothing; knowing that many people are living in poverty does not result in large-scale public assistance. In all of these examples some other knowledge or belief interferes: economic factors, for example corporate profits or threat of unemployment, may influence actions concerning treatment of industrial effluent; knowing that a protective suit is cumbersome and expensive may prevent an agricultural worker from taking appropriate precautions; and a belief that the poor are in financial plight because of a preference for living on handouts may prevent voters approving welfare programs. But whatever the reason, there is no necessary relationship between knowing that an adverse condition exists, and that a possible solution is available, and implementation or approval of the remedial action.

Attitudes and Knowledge. The supposed causal link between attitudes and knowledge represented in Figure 1 and Figure 3 is not strongly supported by research evidence. There are sufficient instances where this link has not been demonstrated to rule it out as a valid generalization. Towler and Swan, for example, found that elementary school students expressed attitudes of concern for "the deterioration of the environment" when administered a questionnaire related to "air, water, and solid waste pollution." However, "their answers revealed a surprising lack of knowledge about the factors which effect the environment, how they effect it, and the degree to which they are personally involved in the problem."[18] A similar lack of relationship was demonstrated in a companion survey of secondary school students reported in the same paper.

Another example of the absence of a strong connection between knowledge and attitude was demonstrated in Barnett's study of the members of Zero Population Growth, Inc. Among members who were under thirty years of age and had no more than one natural child, (i.e. those who had not yet exceeded the number of natural children necessary for an immediate halt to population growth and who were still in their child-bearing years),

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[18] John Towler and James E. Swan, Journal of Environmental Education 4(1):54-57, 1972, p. 54.

> knowing that one child is necessary for immediate population stability . . . has no bearing on personal intentions for less than two versus two natural children, and a majority of those recognizing the necessity of the one-child family intended to have two natural children--even when they believe the United States is already past its optimum population size.[19]

Even in a larger sample in a repeat survey of ZPG members, when it was demonstrated that more members knew that a one-child family is required for immediate population stability, the relationship was very slight; only 7.5 percent of the variance in intended family size could be accounted for by knowledge of the requirement of a one-child family.[20]

These two examples are sufficient to demonstrate that there is no necessary, intrinsic relationship between knowledge about what is needed to solve a particular problem and personal attitudes predisposing individuals to carry out the appropriate actions. Thus a dependence on the Southern model of environmental education, with the implication that it is only necessary to provide knowledge to ensure that actions will follow, is foolhardy.

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[19] Larry D. Barnett, BioScience 21:759-765, 1971, p. 764.

[20] Larry D. Barnett, "Zero Population Growth, Inc.: A Second Study." Unpublished paper, no date, p. 18.

The reverse relationship in Figure 3, "attitudes of concern generate a search for knowledge," is of course an idealized objective. It may hold for some people with respect to some attitudes, but the occurence of strong advocacy of "environmentalist positions" in the absence of supporting data rules it out as an inevitable causal relationship.[21]

Advocates of outlawing non-returnable containers have often acted without sufficient evidence to firmly base their position on hard data. The argument that the use of the same bottle a number of times reduces the drain on the natural resources used in glass manufacture, and on the energy needed to manufacture and distribute the bottles, only considers one side of the question. Adequate data to assess the consequences of this action do not appear to exist. Answers to the following questions are needed before an adequate judgement can be made: how much detergent and other cleansing materials are added to the receiving water from the bottle washing plant? What is the relative energy consumption in reusing bottles and melting them down for new glass? How much additional fuel is used in transporting waste glass to a glassworks compared to returning reusable bottles to a retailer and then to distributors and beverage plants? What is the effect on littering (i.e., aesthetic aspects) of a deposit on returnable bottles? What is the risk to health from inadequately washed bottles? (There have been occasional fatalities from deposits of weed killer or other poisons stored in bottles before they were refilled).

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[21] The campaign used by the Worthington, Ohio, students who attempted (unsuccessfully) to obtain the passage of a city ordinance that would prevent the sale of beverages in cans illustrates the point. The campaign was mainly emotive, and based on an anti-litter position, with little argument concerning the possible adverse effects on natural resource depletion. Consideration of the economic and "environmental" costs of alternatives was not made. (Dean Freund, Worthington City Schools, personal communication).

Attitudes predisposing individuals to buy beverages in returnable bottles do not appear to have generated a search for the data needed to assess this behavior adequately. It may have generated the selection of data to support the action, but a biased selection of data may give a false sense of rationality, and ultimately hinder full assessment.

The possibility that widespread public attitude inculcation may stimulate research by an interested party is not relevant to the assessment of the models shown in Figures 1, 2, and 3. The response of the Aluminum Association to the belief that the use of aluminum cans is more "harmful" than steel cans because of the extra energy required for production,[22] for example, is not relevant to this discussion. Although the industry has calculated comparative energy budgets in response to a (feared?) consumer attitude, this is not evidence to support the models. The models are based upon possible relationships for the individual learner, and data that show the effects of one individual (or group) upon another's actions should be avoided in attempts to support the models.

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[22] The Aluminum Association has produced three brochures summarizing their data concerning the economic and energy costs of aluminum in cans and other products: "Litter, Solid Waste and Aluminum Recycling;" "The Solid Waste Crisis: One Answer;" and "Questions and Answers About Aluminum and Energy Use." (All published 1972, and available from the association, 750 Third Avenue, New York, N.Y., 10017).

Attitudes and Actions. There are a number of difficulties in assessing the relationships between attitudes and actions that are indicated in the models of Figures 1, 2, and 3. One major problem concerns the definition of "attitude." In most of the environmental education literature "attitude" is best interpreted as "a predisposition to act" in a particular manner. Any single action cannot be used as evidence that a person has a particular predisposition, and, conversely, failure to act in the anticipated manner on particular occasions does not constitute evidence that he lacks the appropriate attitude. There are many things that may interfere with the expression of the attitude by action. A person may be under pressures restraining him from action consistent with his attitude; another competing attitude may take precedence at a particular time; or he may even be attempting to play the role of a person with attitudes different from his own.

The "predisposition" account of "attitude" prevents a direct test of the relationships proposed in the models, for predisposition does not entail action. At most, it implies that the predicted action will occur "with a certain probability." As Figà-Talamanca points out in connection with studies of the relationship between attitudes and behavior in family-planning

> if a woman expresses a favorable attitude toward the idea of a small family, we might expect her, with a "certain probability" also either to be a user or a potential acceptor of some contraceptive technique. The only problem is that . . . it has been difficult to establish what this "certain probability" is, and even if it is established, it

> is so small that the attitude loses its predictive value.[23]

Other difficulties in assessing the relationship between attitudes and actions concern the degree of correspondence of "verbalized" attitudes to "predispositional" attitudes. Bart, for example, interprets some data obtained in the Keep America Beautiful study of attitudes toward littering and the actions of respondents as evidence that "though young adults may have strong public attitudes against littering, their private attitudes and actions tend to be in discord with their public attitudes against littering."[24] This comment reflects the difficulty with paper and pencil tests: it is possible to report verbal attitudes in public, but hold private predispositional attitudes. In studies of family planning it is tacitly assumed that answers concerning the respondent's intended family size are accurate measures of the number of children that a person will actually have.[25] However, this statement may be another form of public verbal attitude, and may not be related to the number of children that will be included in the completed family.

The preceding discussion emphasizes that it is difficult to design experiments that could possibly refute the claim that attitudes are good predictors of behavior when "attitudes" are considered as "predispositions to act," and illustrates the difficulty of treating indirect, paper-and-pencil attitude measures as equivalent to predispositional attitudes. This causes a number of difficulties for educators. For example, if there are no valid measures of predispositional attitudes toward completed family size other than inference from the actual number of children in the family, it becomes very difficult to assess the effectiveness of any attempt to alter student's attitudes towards personal fertility in time to have a realistic effect on an educational program designed to help stabilize national population size. To wait for up to twenty years for the evaluative data does not provide sufficient opportunity for revision of the program in the light of measures of effectiveness.

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[23] Irene Figà-Talamanca, Journal of Marriage and the Family 34: 336-344, 1972, p. 338.

[24] William M.Bart, Journal of Environmental Education 4(1):10-14, 1972, p. 10.

[25] See, for example, Larry D. Barnett, Demography7:53-60, 1970.

Despite these difficulties, data on attitude change techniques are available, and are often based upon changes in actual behavior. McGuire, for example, examines the techniques used in attitude change research, listing suggestion situations, where a description of an attitude or behavior is presented repeatedly to a person until he carries out the suggestion; conformity situations, where the attitude change induction consists of presenting a normative description of the attitude of a peer group or authority figure; group discussion situations, where the members of a group present their conclusions on a topic, together with supporting arguments, and specific counter arguments against the subject's position; persuasive messages, where a previously prepared presentation is given to the subject; and intensive indoctrination, including "child rearing, psychotherapy and brainwashing."[26]

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[26] William J. McGuire, in The Handbook of Social Psychology, 2d. ed., ed. Gardner Lindzey and Elliot Aronson (Reading, Mass.: Addison-Wesley, 1969), Vol. 3, pp. 175-177.

However, results from the attitude change research conducted by social psychologists such as McGuire are difficult for educators to apply at this stage. The research is mainly concerned with laboratory studies designed to elucidate the nature of attitudes or techniques for attitude change. Even in this limited area the results are far from conclusive:

> Results /of current work/ often seem contradictory and inconclusive. What is obvious now is that the simple questions with which attitude change and dissonance research began do not have simple answers. What is needed now is the labor of defining the conditions for one effect as opposed to its opposite: When does fear facilitate change, and when does it inhibit it? When are large incentives most effective, and when are small incentives more useful?[27]

Validity of the Models. The preceding discussion indicates that there is no evidence to suggest that models are valid if they are interpreted in terms of inevitable connections. Thus the assumption made by Southern, for example, that knowledge will lead to attitude development, which will in turn lead to appropriate actions, is invalidated by the evidence. It is still possible that the models may be valid if interpreted in terms of necessary prerequisites, or pedagogically effective sequences. Firstly, knowledge is a necessary prerequisite for appropriate action, even if it is only knowledge of rules of behavior with ignorance of the data that lead to the rules. Secondly, there is some evidence, presented when the model in Figure 3 was proposed earlier in this chapter, that attitudes of concern do sometimes lead to generation of needed information, so that the individual may gain knowledge as a consequence of his attitudes.

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[27] David O. Sears and Ronald P. Abeles, Annual Review of Psychology 20:253-288, 1969, p. 279.

Provided the models are interpreted in the weak sense, and not taken to imply necessary connections, it is possible that they may be valid. However, this weak sense is of little predictive value to educators, and the models are probably of limited utility.

Programmatic Arguments Against Attitude Inculcation. It is difficult to justify attempts to inculcate an array of "environmental attitudes" to particular options: for example, the use of returnable beverage bottles; buying steel rather than aluminum cans; avoiding colored toilet paper; prefering non-leaded gasoline; washing with low-phosphate detergents or soaps; and considering more than two children per family to be "immoral." There is a clear danger in this approach, where the position of the most vocal self-proclaimed "expert" or the opinion of the "committed environmentalist" is taken to be self-evidently true. These positions are often advocated on the basis of an incomplete analysis of the available data, or, perhaps more seriously, are derived from a complete analysis of the known data, but with unforseen consequences developing. Examples of each type will be cited here. The classification is not meant to indicate a dichotomy of mutually exclusive types of "errors:" it is of course possible for a particular position to be suggested after an incomplete analysis of the existing data, and when implemented, have consequences that could not have been forseen from the available data even if they had all been taken into account.

In the widely circulated Domebook, where advice on construction of homes based on the geodesic dome of Buckminster Fuller was offered to individuals or communes who wished to break from the "ties to the established building industry and bankers, architects and inspectors,"[28] and live a life in harmony with nature, builders were advised to use synthetic materials. This advice was based on the grounds that using timber would add to the destruction of forests and contribute to ecological destruction. That is, materials produced from non-renewable resources, and which are often not broken down by soil organisms if abandoned, were suggested. Timber is a renewable resource, and, if discarded, will ultimately decay. The recommended choice is *more* likely to result in "environmental contamination" and destruction than using wood.[29]

Errors that result in unforseen consequences are likely to be more serious than the acceptance of advice to build dome houses out of plastics and steel, for they may directly affect well-being. Examples concerned with attempts to reduce noxious or toxic gases from car exhausts are instructive. After treatment of industrial sources had proved ineffective, efforts to decrease Los Angeles smog centered on the reduction of hydrocarbon content of car exhausts. The addition of crankcase ventilators and the redesign of the combustion and exhaust systems is effective in reducing the concentration of hydrocarbons in the exhaust gas. Cars fitted with these devices showed an average decrease of 35 percent in exhaust hydrocarbons,[30] compared with results of similar 1963 models. In Los Angeles, the average hydrocarbon concentration in the air decreased by 12 percent from 1965 to 1968.[31] (The smaller decrease in the city air is partly a consequence of fitting only new cars with the devices).

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[28] *Domebook 2* (Bolinas, California: Pacific Domes, 1971), p. 3. See also p. 114.

[29] Ibid., p. 18, p. 19. (The original argument from *Domebook One* is reprinted, and the analysis corrected by presenting alternative data, including the comparison between renewable forest resources and non-renewable "minerals retched from the earth, or petroloeum sucked from the earth.")

But these control techniques for hydrocarbons increase the operating temperature of the engines, leading to an increase in the production of nitrogen oxides, mainly nitric oxide with some nitrogen dioxide. Ford and Plymouth models operating in low altitude cities had an average increase of 44 percent in oxides of nitrogen over the 1963 baseline; Chevrolet had a similar increase at high altitudes, but a slight decrease in low altitude cities.[32] The increase in the nitrogen oxides concentration in the Los Angeles air from 1965 to 1968 was 28 percent.[33] Nitrogen dioxide is toxic; nitric oxide is one component of the photochemical oxidation reactions that lead to the formation of the eye-irritant peroxyacetyl nitrate (PAN).[34] Thus attempts to apply known technology to remove the hydrocarbon compounds from the use of motor vehicle gas produced an increase in another contaminant. From hindsight we can see that the effect may have been predictable, given knowledge of the combustion temperature and data on the combination of nitrogen and oxygen at high temperatures, but there were no extensive automobile data at that time.

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[30] Walter F. McMichael _et al._, _Journal of the Air Pollution Control Association_ 19:246-248, 1968.

[31] Barry Commoner, _The Closing Circle_ (New York: Knopf, 1972) p. 71, citing Fuller _et al._, 1967. (See _Closing Circle_, p. 307.)

[32] Walter F. McMichael _et al._, _Journal of the Air Pollution Control Association_ 18:246-248, 1968.

[33] Barry Commoner, citing Fuller _et al._, 1967. (See _Closing Circle_, p. 71 and p. 307.)

[34] Irving R. Tabershaw _et al._, _Journal of Occupational Medicine_ 10:464-484, 1968, p. 465.

The experience of exchanging one problem for another in exhaust emission control has been salutary. Much more extensive investigations are now being made by groups interested in rectifying the nitrogen oxides emission problems. The catalytic method of reducing the concentration of nitrogen oxides in exhaust gases depends upon the continued activity of the materials that catalyse reactions such as:

$$2NO + 2CO = N_2 + 2CO_2$$

$$2NO_2 + 4CO = N_2 + 4CO_2$$

Other similar reactions are possible.[35] Catalysts currently under investigation are, however, "poisoned" by the presence of the lead compounds added to gasoline to increase the effective octane rating. One study reports that the effective life of some catalysts may be the equivalent of only 20,000 miles of driving.[36] It would seem, therefore, that current advocacy of the removal of lead from gasolines is soundly based, particularly as the lead compounds emitted in the exhaust may have some deleterious effects to health in their own right.

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[35] J. Bagg, in *Air Pollution Control, Part I*, ed. Werner Strauss (New York: Wiley-Interscience, 1971), p. 83.

[36] L.J.E. Hofer *et al.*, abstracted in U.S., Department of Health, Education, and Welfare, Public Health Service, Environmental Health Service, National Air Pollution Control Administration, *Hydrocarbons and Air Pollution: An Annotated Bibliography*, National Air Pollution Control Administration Publication AP-75, 1970, p. 467.

However, unleaded gasolines have some undesirable side effects. In one study a fleet of cars fueled with unleaded gasoline reduced visibility and deposited more soil on test filters than a comparable fleet using leaded gasoline.[37] Increased carcinogenesis resulting from exposure to the exhaust products of non-leaded fuels may be a more serious danger. The effective octane rating of the low-lead or non-leaded fuels is maintained in most cases by the inclusion of aromatic compounds in the formulation.[38] The amount of the carcinogen 3,4-benzpyrene produced increases with the amount of aromatic hydrocarbons in the fuel.[39] At best the arguments for the immediate removal of lead from gasolines are based on tenuous data; the balance of positive and negative effects of such actions is not yet clear. Given this situation, Presidential recommendations that the use of low-leaded gasoline be encouraged by tax incentives[40] and the eco-activists recommendations that consumers choose low-lead gasolines may be examples of recommending actions based on an incomplete analysis. But, in contrast to the proposals to remove hydrocarbons by increasing combustion temperatures, there is a serious questioning of the consequences of immediate lead removal and maintenance of the fuel quality by adding hydrocarbons. It is therefore more likely that ultimate decisions concerning the fate of lead in gasoline will be made on the basis of more adequate evidence than previous actions.[41]

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[37] John M. Pierrard, Science 175:516-518, 1972.

[38] Edward J. Farkas, Science 174:545, 1971.

[39] R.G. Temple, in Air Pollution Control, Part I, p. 183.

[40] Richard Nixon, President's Message, in Environmental Quality. The First Annual Report of the Council on Environmental Quality (Washington, D.C.: Government Printing office, 1970), p. x. See also p. 78, for the rationale for a tax of $4.25 per pound of lead used in gasoline.

But suppose that the advocates of lead-free fuels are successful in inculcating an attitude that produced strong buyer resistance to leaded fuel. If the ultimate evidence shows that leaded fuel is in fact more desirable than one containing high concentrations of aromatics and it is decided that a partial recycling of exhaust gases to the combustion chamber is the most effective method of reducing nitrogen oxides, it may be difficult to reverse buyer preferences. Buyers may insist on the more damaging fuel.

Thus there are additional reasons for rejecting the strategy of deliberately attempting to inculcate an appropriate attitude concerning each "environmental problem" that is perceived. The attitude may be based on a false analysis of the available data; it may be based on a conclusion that is at best tenuous; or it may be only appropriate for a narrow geographic or temporal range. The last instance implies that continual formation of attitudes will be required as new problems arise; it is highly improbable that any group will be able to predict all attitudes that will be "needed" in 1980, let alone 1999. The possibilty of successfully inculcating an attitude that is in fact inappropriate is more serious than the implied necessity of continued deliberate attempts to produce attitudes toward each new problem. Continued changing of "desirable" attitudes will, at best, result in loss of credibility; at worst, the populace may continue to act in accord with the "old" attitude, thus worsening the situation the attitude was intended to alleviate.

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[41] Despite the absence of complete data, some prohibitions already exist. New York City, for example, passed an ordinance in August, 1971, which requires a stepwise reduction of lead in gasoline sold there, with complete elimination by January 1, 1974. See Robert J. Bazell, Science 174:574-576, 1971, for a discussion of the arguments for and against the ordinance. The debate focussed on the effects of lead *per se*, and did not consider the effects of alternative formulations.

The previous arguments against inculcation of particular attitudes toward specific environmental problems--lack of educationally useful attitude measures and the danger of inculcating the "wrong" attitude-- are reflected in Hendee's comment: "Environmental education should focus on closing /the/ knowledge and participation gap and not on closing minds by trying to specify attitudes."[42]

The Propriety of Attitude Inculcation. In Chapter V some examples of the dispute concerning the inculcation of particular attitudes toward environmental parameters were given. This conflict will be examined in a little more detail here, although the previous arguments for rejecting this approach are sufficient to make this discussion redundant. The issue of indoctrination will therefore be treated briefly, although it is not an unimportant concern. In the particular case of environmental education, however, the justification for rejecting a prime focus on attitude formation does not depend upon the issue of indoctrination; sufficient reasons for denying the utility of inculcating particular predispositions have been proposed earlier.

Opponents of the inculcation of particular attitudes to the array of presently recognized environmental problems sometimes refer to this procedure as "indoctrination." Morgan, for example, warns against indoctrination when discussing the teaching of social issues in biology and in environmental education.[43]

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[42] John C. Hendee, Journal of Environmental Education 3(3), unnumbered cover page, 1972.

Flew recognizes two senses of indoctrination. The primary sense of indoctrination, where the label is applied pejoratively, "is a matter of trying to implant firm convictions of the truth of doctrines which are in fact false or at least not known to be true." In the secondary sense, indoctrination is a matter "of trying, in any sphere what ever, to implant beliefs, even those which are true and known to be true, by certain disfavoured methods." (Disfavored methods would be those that were in some way "incompatible with the productoon of a proper understanding of what is taught and of a critical appreciation of its logical and epistemological status." Flew points out that this is a practical question, rather than a theoretical one, with the test of the method being the understanding demonstrated by the learner).[44]

Flew insists in his paper that any inculcation of beliefs is not necessarily an example of indoctrination; the beliefs inculcated as true, as well as being false or unproven, must be concerned with ideologies of some sort. Given this account of indoctrination, is there any justification in using the term in reference to the particular predispositions of which environmental educators speak when they advocate the inculcation of attitudes?

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[43] David G. Morgan, in "Biological Education in Australian Secondary Schools," ed. A.M. Lucas (Duplicated report presented to the Australian Academy of Science, 1970), p. 93; and in Education and the Environmental Crisis, ed. Jeremy Evans and Stephen Boyden (Canberra: Australian Academy of Science, 1970), p. 50.

[44] Antony Flew, Studies in Philosophy and Education 4:281-306, 1966. All quotations are from p. 305.

We have seen earlier in the chapter that at least some of the attitudes inculcated are based on false or unproven premises. But producing an aversion to purchase of leaded gasoline, or soft drinks in non-returnable bottles, would scarcely be construed as ideological.

The vehement advocacy by some eco-activists of a "return to nature" and a rejection of the perceived "growth" ethic of industrialized societies takes on the fervor of an ideology in many cases. The beliefs and associated predispositions to act that advocates of these positions attempt to inculcate may also be false, or at least not known to be true. The assumption that the source of the nitrogen atoms in the protein of grain affects the nutritional quality of the food produced from it is one example: this belief is held by some of the "natural food" advocates within the eco-activist's counterculture. Apparently they believe that the use of urea produced in a factory confers harmful attributes on the food compared to the urea added in the form of animal wastes.[45]

Opponents to the counterculture eco-activists also attempt indoctrination in many cases. For example, the belief that economic growth is the only measure of a nation's strength and worth is often viewed as a doctrine. The attempted inculcation of growth-oriented attitudes would then count as indoctrination, in Flew's primary sense.

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[45] See Emanuel Epstein, Science 176:235, 1972, and a letter from Joel H. Hildebrand, Science 177:944-945, 1972 for some comments concerning the beliefs about organic gardening, plant nutrition, and chemical naivete.

Even where 'indoctrination' can properly be applied, the mere application of the label is not a sufficient argument against the practices if the primary sense of 'indoctrination' is implied. To be convincing it is necessary to show why the label is justified. This will mean that arguments similar to those used in previous sections will be necessary: Are the beliefs upon which the attitudes are based known to be false? Is there reasonable doubt about the veracity of the belief? That is, by demonstrating that indoctrination is occuring we will be necessarily demonstrating the premises that are in doubt. It is on the basis of the doubtful foundation that the attitude inculcation is rejected, not on the label "indoctrination."

Inevitability of Attitude Formation. Despite the arguments against basing an environmental education program on the inculcation of an array of particular attitudes it must be recognized that teachers will be an important influence on the formation of attitudes toward social problems, including those refered to as "environmental." Classroom settings inevitably provide at least two of the types of attitude change situations outlined by McGuire: suggestion situations and conformity situations.

Sufficient repetitions of situations suggesting the undesirability of furnace smoke may produce an automatic adverse reaction to such industrial undertakings. This need not be repetition of overt statements. Selection of examples for history lessons, for instance the production of the "Black Country" in industrializing England; in biology classes, e.g., the use of industrial melanism to illustrate evolutionary change in a short period of time; and in mathematics lessons, (where students may be asked to use "data" such as "when the sulfur dioxide content of the air in New York city rises above .2 parts per million, ten to twenty people die as a result. In the past five years, sulfur dioxide has reached this level at least once every ten days,"[46] as a basis for computation exercises such as "How many people died in New York city during the last five years because of sulfur dioxide air pollution?"[47]), could conceivably result in the inculcation of an attitude of aversion to industrial plants. Continued selection of such examples, which may be correct in themselves, could provide a biased set of beliefs leading to a particular predisposition to act.

Conformity situations arise in classrooms when the perceived attitudes of the authority figure (teacher) and the perceived normative belief of the class exert a pressure on the student to bring his own attitudes and beliefs into line. Once again, this need not be overt pressure. Continued discrepancy between an individual's behavior and that of his classmates, and the expected behavior of the teacher,in similar situations, may exert sufficient subtle pressures for a person to act in a similar manner. According to some theoretical interpretations of motivation and attitude change this consequent action can eventually lead to a change in personal disposition to act, as the individual reduces dissonance between his actions and his original attitudes.[48]

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[46] George L. Henderson and Mary Van Beck, The Mathematics Teacher 64:33-36, 1971, p.33.

[47] Ibid., p. 34.

It is extremely difficult for a teacher to avoid situations where pressures of suggestion or conformity could eventuate, even if he does not consciously attempt to inculcate particular attitudes toward selected issues. Perhaps it is preferable in this situation to deliberately choose the attitudes that are to be inculcated. If this is done, perhaps less damage may be done in the long run.

Emphasize Rational Attitudes. Both writers whose positions were used in Chapter V to illustrate the opposition of some educators to the use of environmental education programs to inculcate particular attitudes to specific problems advocate the formation of general attitudes which are applicable in any situation, whether related to environmental deterioration or some other social or personal issue. Both Ivany and Morgan imply development of a disposition for taking rational actions. They would aim at producing students with a generalized social concern, who are willing to consider all available evidence before making a decision to act in a manner compatible with societal well-being, and who are willing to change their decisions when additional evidence becomes available.

Inculcation of a predisposition toward rational actions cannot be objected to on the same grounds as the inculcation of particular attitudes. If the inculcation is successful, then the actions will not be based on partial analysis of data supporting only one viewpoint, actions will be changed when new evidence that suggests that the previous analyses were incomplete becomes available, and a deliberate search for opposing evidence will be made when action is contemplated. That is, programs attempting to inculcate these attitudes will be aimed at producing open minds, not minds closed by providing the solutions.

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[48] See E.E. Davis, Attitude Change: A Review and Bibliography of Selected Research. Reports and Papers in the Social Sciences No. 19 (Paris: UNESCO, 1964), particularly Chapter 2, for examples drawn mainly from research on social prejudices.

"Rational actions" do not, of course, require complete certainty of outcome. In many cases actions must be taken although complete evidence is not available, and cannot be obtained in the time available before action must commence. In these cases, therefore, a rational action will be one that takes into consideration all of the evidence presently available, which is consistent with the weight of the evidence and of informed extrapolative predictions, and which keeps open as many options as possible consistent with alleviation of the current problem. For example, all of the evidence concerning the economics and necessity of recycling metals is not yet available.[49] What there is suggests that in the future there will be a need for the reuse of metals, and that the best method of ensuring their future availability is disposal in landfill. Landfill represents an effective method of waste removal which, if carefully conducted, raises few public health problems.

If metals to be buried are separated into ferrous and non-ferrous metals, and each is buried in known separate positions, the landfill can be a valuable source of minerals at a later date. The concentrated "ore body" can be easily "mined" if needed later.[50] But certain precautions will have to be taken if the option of retrieval is to be maintained: the land-fill cannot be used for housing or industrial purposes, but its function as a reserve of "ore" will not be impeded if it is retained as an open space; for example, for recreation or agriculture.

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[49] Walter O. Spofford, Jr., Environmental Science and Technology 4:1108-1114, 1970, discusses some of the issues, and evaluates the "worth" of some specific recycling projects, using both a market and a social viewpoint.

Under some circumstances a rational decision may be to act in an apparently irrational manner. For example, if it is impossible to obtain data necessary for a decision it may be possible to force an affected group to obtain the data by inducing a buyer boycott of certain goods. The widespread claim that the use of colored toilet paper is ecologically unsound, for the dyes impede development of normal ecosystems in receiving waters, was not founded upon adequate data. Never-the-less, the claim prompted paper manufacturers to conduct intensive analyses, with the result that no evidence for deleterious effects could be found. Thus an action by one group of people induced the generation of new knowledge.[51] However, the same example points up another danger: actions taken to stimulate the generation of data by affected groups could be self-sustaining. The moves against colored toilet paper do not appear to be diminished by the availability of data. The credibility of data reported by an interested party also has to be taken into account, for some of the public "converts" may not accept the validity of a company's research concerning the possible deleterious effects of one of its own products.

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[50] The thermodynamic costs of retrieval from such a land-fill are clearly less than those of recovery of widely dispersed materials. See R. Stephen Berry, Bulletin of the Atomic Scientists 28(5):8-15, 1972, for an account of thermodynamic costs of recycling in the case of motor vehicle production. He provides some data on the thermodynamic costs of complete dispersal of discarded materials that would be applicable in the evaluation of a land-fill project of the type suggested here, (p. 11).

[51] See discussion between Michael F. Brewer and James Shipman in Environmental Quality and Social Responsibility, ed. Ravindra S. Khare et al. (Green Bay: University of Wisconsin--Green Bay, 1972), pp. 30-32.

Importance of Values. Insistence on a rational approach in environmental education does not rule out consideration of attitudes, values, and beliefs. Two groups could accept the evidence indicating that certain policies will increase the flow of tourists into a natural area. However, their basic value systems might produce violent disagreement concerning the appropriateness of implementing those policies, e.g., a motel operator and a backpacker could advocate opposite sides of the question of building new highways to a previously primitive region. Citizens need to be able to recognize the value differences in society, as well as judge the ecological, economic, and public health data concerning any issue. Teachers must, therefore, consider the effects of values on decision making on environmental issues.

But a mere knowledge of the fact that differences between values exist is not enough. Students must be helped to formulate their own value choices, and the teacher must encourage and guide the examination of personal values as they relate to public issues. To do otherwise, to refuse to consider values at all, is an abrogation of the duty of the teacher to adequately prepare students to make decisions concerning public issues. A student aware of the empirical data, but not aware of the influence of other's values on their actions, and vague about his own personal value systems, will be making his decisions with data more incomplete than is necessary or advisable. However, in a society that is not monolithic with respect to values, the teacher does not have the right to impose his own personal values systems or to so strongly advocate a particular policy that the student becomes inculcated with his views. The teacher's task is difficult. He must tread the line between encouraging the formation and examination of personal values on the one hand, and the imposition of his own set of values and policies on public issues on the other.[52]

Personal Experience? The claim that education must take place in the environment to count as 'environmental education' is also rejected. There is no doubt that exposure to examples of bad planning, of inadequate solid waste disposal, or of despoiled wilderness areas may motivate some students to study these situations. Personal experience can also provide a more concrete basis for understanding the issues than can be provided in the classroom. But there is the danger that the students will come to reject evidence collected by others.

There is some evidence from studies of modern science education curricula, that emphasize student collection of data in personal experiments, that some students tend to become overly sceptical of any published data. Lucas and Broadhurst, in a study of biology students using an Australian adaptation of the Biological Sciences Curriculum Study materials, report a prevalent misunderstanding of the role of accumulated evidence in scientific research. They comment that this tendency may be "an unfortunate consequence of a strong emphasis on empiricism and personal experiment in modern science courses. Students may come to value only data or interpretations that they themselves have made."[53] Meyer, who found a similar trend in his study of Nuffield O-level science courses in England, comments that there is a "danger that methods other than direct experience will become held in contempt even when empiricism is impracticable or inappropriate in a learning situation."[54]

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[52] A fuller discussion can be found in James P. Shaver, Journal of Environmental Education 4(1):49-53, 1972. See, particularly, p. 51.

This danger must be borne in mind by advocates of direct experience in the environment. In many real life situations citizens have to rely on data collected by persons with the facilities and expertise required: citizens concerned about the effects of radiation damage resulting from the installation of nuclear power plants cannot generate the necessary data for themselves. A dispute of this type requires use of data collected from other plants in operation elsewhere, historical data concerning background levels of radiation, and epidemiological studies of the effects of different levels of radiation on humans. Even if the affected citizens had the expertise necessary to collect and interpret radiometric data, they are most unlikely to have commenced collecting background data before plans to build a power station were announced.

In less extreme situations than construction of a power station similar lack of expertise and access to instrumentation are likely to interfere with effective first-hand data generation. It is clear that knowledge of library searching is one of the skills needed for effective decision making in environmental areas. Excessive emphasis on education *in the* environment may reduce the value students place on collection, selection, and interpretation of relevant data from information already available. Effective use of general library data can, at the very least, direct attention to the needed information about the current issue; at best it can supply sufficient data to obviate the expense and time needed to collect equivalent data from the local setting.

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[53] A.M. Lucas and N.A. Broadhurst, Australian Science Teachers Journal 18(1):66-74, 1972, p. 72.

[54] G.R. Meyer, Journal of Research in Science Teaching 7:283-302, 1970, p. 293, (his emphasis).

Summary

The issues that must be faced in choosing the features of an environmental education program, the choices made in this chapter, and the reasons for each choice, are enumerated here. The choices made are not the only possible defensible positions. They are a function of my particular value system, and it is likely that a reader with a different set of values will reject some or all of the choices. However, whatever the educator's values, he must consider the issues raised here if he is to have any claim to a judgement that takes into account the potential ambiguities in discussions of 'environmental education'.

Purpose. The basic purpose of my consideration of the effects of environmental parameters on humans is concern for individual welfare. This choice is in accord with a value system respecting individual rights, and is less likely to lead to a denial of rights than choosing to consider the effects of the environment on larger groups, for example the nation or the species.

Referent. The entity chosen to be the referent of 'environment' follows from my purpose of considering 'environment' and 'environmental education'. I use individual humans as the referent.

Relevant Environmental Components. Biotic, physical, and socio-cultural components of the Universe external to the individual are relevant for a discussion of 'environmental education'. The extension beyond *the* environment is deliberate, and has been made to force consideration of social parameters in environmental education programs.

Instead of attempting to rank common "environmental problems," such as resource depletion, accumulation of toxic products, and diminution of wilderness areas, to decide which should be accorded high priority in educational programs, I propose a consideration of the essential features of individual well-being, both "physical" and "psychological," so that the reasons for studying environmental effects are clear, and so that the chance of recognizing potential interactions of different components of the environment is increased.

Factors affecting cellular respiration are accorded the highest priority, for without an adequate supply of cellular energy life is impossible, and the other components of well-being become meaningless. When considering lower priority components of individual well-being, such as transport, the cost of this component on the primary factor of cellular energy is one of the prime considerations in weighing alternate methods of achieving satisfaction.

Class of Environmental Education Program. I advocate an environmental education program that fits the combined class 'education *about* and education *for* (the preservation of) the environment', with a heavy emphasis on education for the environment. The education about the environment components act as vehicles for the needed knowledge 'that' and knowledge 'how' that are essential prerequisites for effective action. However, existing models connecting knowledge, attitudes, and environmental actions are rejected as far as they imply necessary connections. Evidence presented shows that attitudes do not entail knowledge, knowledge does not entail attitude formation of a particular type, and neither knowledge nor attitude entail particular actions. In addition, there are practical dangers if particular attitudes to specific issues are successfully inculcated. For these reasons, an emphasis on inculcation of specific attitudes toward an array of presently perceived problems is rejected. However, to increase the chances of appropriate data being sought, and decisions based on evidence being made, when future problems arise, I advocate teaching consistent with the development of attitudes of social concern and preference for rational action. This implies that the effects of personal values be examined in environmental education programs, and that students be encouraged to examine the basis and implications of their own value systems. But the teacher should attempt to avoid imposing his own values and derived policy decisions on his students.

The argument that all environmental education should take place in the environment, (i.e. outside the classroom), was rejected as unrealistic and possibly counterproductive. Some motivational and cognitive advantages of education in the environment exist, but the possibility that students will come to reject all data that are not gathered at first hand leads to an insistence that at least some environmental education be conducted using second-hand data, particularly that found in libraries.

CHAPTER VII

'BALANCE OF NATURE' AND 'POLLUTION' IN AN ENVIRONMENTAL EDUCATION CURRICULUM

The position advocated in the last chapter requires a critical examination of descriptions of environmental phenomena. One form of evaluation that should be used is the examination of the basis of applying apparently descriptive labels such as "pollution" and the "balance of nature." Unless this is done there is a danger that policies will be advocated in the belief that there is such a thing as the "balance of nature" that can be restored, and that it is possible to objectively identify instances of "pollution" that everyone would agree should be eliminated.

These two terms, "pollution" and "balance of nature," are useful examples. They are used widely in the environmental literature, and they are both powerful rhetorical devices: it is very difficult for anyone to be _against_ the "balance of nature" or _for_ "pollution." However, a rational approach should get below the emotive implications of the terms, and examine the validity of their use as descriptive class labels. 'Pollution' does not seem to be adequately analyzed, so the bulk of this chapter consists of an essay examining the nature of 'pollution' and its possible use as a descriptive, rather than a rhetorical word. 'Balance of nature' will not be examined in detail here, for it has been well reviewed in a paper by Ehrlich and Birch. Their conclusions are summarized below, but the reader is urged to read their entire paper.

On the basis of an examination of the diverse ecological data and the models upon which ecologists have based their conceptions of a "balance" in nature, Ehrlich and Birch demonstrate that the notion of "some sort of 'balance' with respect to population size" is false. In place of the notion of "balance" they conclude that models should take into account the following points: populations of all organisms are constantly changing in size; there is constant change in the environment of all organisms; that local populations need to be studied to obtain a realistic understanding of population size; and that the influence on population size of various environmental components is a function of time, place, and affected species.[1]

Uses of 'Pollution'

The validity of the 'balance of nature' was easy to check, for it depended upon the gathering of available empirical data. The utility of "pollution" as a descriptive tag is not so easily determined, for the usage of the term is much broader than that of "balance of nature:" it has no common subject matter, and does not lead to a set of predictions that can be tested in the way that Ehrlich and Birch were able to test predictions from the 'balance of nature' model; and its use is rapidly proliferating, with moral pollution and species pollution recently added to the classic list of air, water, and soil pollution.

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[1] P.R. Ehrlich and L.C. Birch, American Naturalist 101:97-107, 1967.

"Pollution" is used as if it were a descriptive, unambiguous word, accurately conveying information to the reader. The following examples are sufficiently characteristic of the literature to show that it is a common assumption that "pollution" is meaningful to the reader. (The statements are labelled A-D for later reference.)

> A. Biologically we can recognize pollution as a characteristic density-dependent mortality factor that acts as a natural check on the expansion of populations of most animals.[2]
>
> B. . . . deprecated our almost total lack of knowledge regarding the ecological effects of long exposure to low levels of pervasive chemical pollutants.[3]
>
> C. Electric power production from fossil fuels is a major cause of urban air pollution; produced from nuclear reactors it is a source of radioactive pollution. . . Ultimately all electric power, when used, is converted to heat, causing increasingly serious heat pollution problems in cities in the summer.[4]
>
> D. Pollution of the intellectual environment, in which the human mind must function . . . [is] . . . proliferation of trash ideas and extraneous information.[5]

But what information does "pollution" convey? It is clear from these examples that man need not be involved (statement A), that the changes refered to as evidence of pollution need not be shown to be harmful to man or other organisms (B), that pollutants need not be substances (C involves energy), and that the changes need not be physical in nature (D).

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[2] Durward L. Allen, Journal of Environmental Education 2(1):9-13, 1971, p. 9.

[3] Ibid., p. 12.

[4] Barry Commoner et al., Environment 13(3):2-19, 1971, p. 4.

[5] David H. Ost, American Biology Teacher 33:239-240, 1971.

Most dictionary or other definitions preclude at least one of these ordinary uses. Thus, the definition of "pollution" in the unabridged edition of Webster's Third New International Dictionary (excluding the archaic explicitly sexual usage) excludes usage exemplified by example D since it refers to "physically impure or unclean."

Legislative definitions, such as that of air pollution quoted below, exclude both usages B and D: air pollution occurs when contaminants are present

> in such quantities and of such duration as to (a) cause a nuisance; (b) be injurious or be, on the basis of current information, potentially injurious to human or animal life, to vegetation, or to property; or (c) unreasonably interfere with the comfortable enjoyment of life and property or the conduct of business.[6]

What Counts as 'Pollution'?

One source of difficulty with the term is that it is a mixed word.[7] As well as appearing to be a descriptive term it has connotations of an evaluative judgement--pollution is "bad" or "harmful." Thus, to say "X is a case of pollution" is at least to say "I disapprove of X." This implication enables "pollution" to be used rhetorically.

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[6] Metropolitan Air Pollution Control District, Department of Public Health, Commonwealth of Massachusetts, "Rules and Regulations to Prevent Pollution or Undue Contamination of the Atmosphere Within the Metropolitan Air Pollution Control District," (undated), quoted from Environment Law Review 1:186-213, p. 187.

[7] John Wilson, Language and the Pursuit of Truth (Cambridge: University Press, 1965. Paperback edition, 1967), p. 26. That is, the term has descriptive and evaluative connotations.

Additional characteristics of 'pollution' will be examined by reference to a number of cases, some of which are clearly considered instances of pollution, some of which are borderline, and some not counting as pollution in normal usage, although having some features in common with clear cases of pollution.

Example 1: Harmful Technological Emissions. The addition of hydrocarbon compounds to the air by automobile engines and industrial emission of particles and noxious gases, including sulfur dioxide, are classic cases of pollution. In both cases the following characteristics can be clearly seen:

1. A compound not normally present is added to the air by a technological device;
2. The added compounds and particles are harmful to man, causing disease or having demonstrable potential to cause physiological damage.

In addition, these pollutants can cause damage to other organisms. For example, the presence of sulfur dioxide in the air has prevented the regeneration of vegetation in a number of copper smelting regions of the world. Queenstown, situated in a high rainfall area on the west coast of Tasmania, is a clear example of a desert produced in this way.

Converse Example 1: Similar Substances of Natural Origin. Products which are termed "pollutants" if produced as unused products of technological processes may not be considered "pollutants" if they result from natural phenomena. Sulfur dioxide is emitted by many hot springs and volcanic cones; but the air around the cones and springs is not generally refered to as "polluted," even though it may have a similar or higher concentration to that emitted from a powerhouse smokestack.

Example 2: Increases in Natural Components. Gross climatic changes resulting from the operation of large power stations where the excess heat originating in the condensers is dissipated in large evaporators are normally spoken of as consequences of pollution by those plants. In this case the pollutant added to the air, water vapor, is a naturally occuring component of the atmosphere, and the increased cloud cover and changed precipitation patterns are natural consequences of the presence of water vapor in air. Comparison with the following converse example suggests that the power station is said to pollute because the change is an inintended, or, in the initial cases, an unpredicted consequence of the installation of the power plant.

Converse Example 2: Deliberate Climatic Changes. The technique of seeding clouds with silver iodide crystals with the intent of increasing precipitation has been extensively practiced in semi-arid and drought-stricken regions of the world. Most people would not call the addition of these unnatural components to the atmosphere an example of pollution, although it is little different from the unintentional seeding of clouds by particles from aircraft exhausts.

(This example may perhaps be borderline, since it is clear that not all people approve of the seeding. Some litigation has resulted from attempts to break droughts by cloud seeding, e.g., the City of New York was sued by resort owners in the Catskills,[8] and it is conceivable that, under present social conditions, people adversely affected by cloud seeding would refer to the introduction of this foreign matter into the air as "pollution".)

Example 3: Excreted Metabolic Products. The accumulation of human and/or animal excrement in streams and in the streets of cities is one of the oldest and clearest cases of pollution. It is harmful to the human inhabitants, e.g., causing endemic cholera in unsewered cities. Similarly, the contamination of an animal's food supply by its own metabolic wastes is usually considered pollution (from the presumed point of view of the animal?) although no effect can be demonstrated on humans. Statement A, above, provides one example of this type of use.

Converse Example 3: Non-Pollutant Metabolic Wastes. Not all metabolic products excreted by organisms are called pollutants. The clearest case of an excretion never considered a pollutant is the oxygen released by photosynthesizing plants. Presumably we do not call oxygen a pollutant because it is essential for man and most organisms that he regards as desirable, although it would be possible, and consistent with the non-human referent of example 3, to consider oxygen a pollutant from the point-of-view of obligate anaerobic bacteria, some of which play an important role in maintaining favorable conditions for human life. This example suggests that normally the values used in attributing the "pollution" label are anthropocentric, if not egocentric. As shown in example 3, this is not an exclusive characteristic, but it is likely that the label is applied in those cases in an anthropomorphic manner.

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[8] James N. Corbridge, Jr., and Raphael J. Moses, Environment Law Review 1:109-138, 1970, p. 116, (Slutsky v. City of New York).

Example 4: Pollution by Forms of Energy. Pollution by excess heat, statement C, is an example of pollution by energy added to some component of the human environment. A common example of heat, or thermal, pollution, is the heating of air or water by power station operation to the extent that ecological or physiological change results.

There have been serious suggestions that the excess heat from such operations be used for industrial operations or agricultural purposes.[9] Such suggestions are a clear example of the tendency to call useable secondary products of a manufacturing process "by-products," and to call those that we are unable to use "pollutants."

Converse Example 4: All Excess Heat is not Pollution. Some changes in water temperature greater than those caused by cooling power stations are never called pollution. The temperature of inland ponds, for example, commonly increases several degrees during the summer months. They may even dry up, but this is not an example of "thermal pollution" by the Sun. Apparently, therefore, the label 'thermal pollution' is applied when excess man-caused heat produces changes. But this is not a valid generalization: consider the case of a mal-functioning thermostat that causes acute discomfort to the residents of a building which overheats. It would be most unusual to refer to the apartments as "thermally polluted." Perhaps the change caused in this case is of insufficient extent to rate as "pollution."

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[9] Ronald Stewart and S.P. Mathur, Conservationist 25(3):16-20, 1971.

Borderline Examples. Not all cases are as clearly determined as those used in the examples and converse instances above. Some phenomena may count as pollution for some people, but not for others. Four of these borderline instances are described below. The characteristics of these examples helps to elucidate the nature of 'pollution'.

Borderline example 1: Dust-storms

The fine particles of dust resulting from dust-bowl episodes would not generally be called pollutants, although many of them would be in the same size range, and would cause physiological lung damage as serious as industrial particulate emission. In a few cases the designation "pollution" may be applied, particularly if the soil movement was a consequence of farming, but this is unusual. Perhaps the lack of this designation in such cases (where chemical analyses would be unable to distinguish natural from artificial origin as in converse example 1) is because we do not place a moral evaluation on natural phenomena?

Borderline example 2: Music, sound, or noise?

Noise pollution is difficult to delimit. There are few, if any, clearcut cases. Even the apparently extreme case of noise from manoeuvering jets at airports is enjoyed by some people who find excitement in the sound. The extreme criterion of damage to the nervous system is not sufficient to identify cases of noise pollution since few fans of some of the louder modern music would consider a concert of this type an example of noise pollution, even though the participants may suffer permanent damage to the organ of Corti. Other less appreciative hearers are likely to consider the "raucous noise" a "pollution" of their environment, even though they may not be close enough to suffer hearing damage.

Borderline example 3: Visual changes

As in the preceding example, aesthetic judgements are usually necessary to determine whether a particular event or structure is an example of "visual pollution." Quarry scars on hillsides, or even the Mt. Rushmore sculpture, may be considered visual pollution by some. Similarly, the proliferation of billboards along highways can be considered visual pollution for aesthetic reasons. (It is possible to argue that the proliferation of signs may cause driver distraction and thus accidental death or injury, and hence use a damage criterion to label billboards "visual pollution." But even if they worked to keep drivers awake and alert, the billboards could be considered visual pollutants, in as much as they detract from the beauty of an area.)

Borderline example 4: Criterion concentrations

The amount of the substance present in the soil, water, or air can make a difference in the decision whether or not to call it a "polutant." A clear example is found in the regulations related to the control of water quality. Maximum permissible levels of specified substances can be set for particular streams or lakes. Until these are exceeded the water is not officially considered polluted. Under United States Federal guidelines established by the Water Quality Act of 1965 the standards must take into account the present and future uses of each body or stretch of interstate water.[10] That is, the standards may vary from waterway to waterway, and it is possible that one river could be designated as polluted, while another with identical contaminants in identical concentrations could be considered unpolluted. In the first river, action could be taken against the "polluters," but in the second there are no grounds for action against any particular discharger.

It is also relevant to consider cases of high natural concentrations of atoms, such as lead or mercury, in streams uninfluenced by man. Although these streams may exceed the stipulated levels for prima facie cases of pollution, the situation is similar to converse example 1, and they are not always called "polluted." In addition, there is the practical problem of reducing this natural level to or below the administratively determined levels. If no reduction is attempted, can industrialists claim to be discriminated against when penalized for "polluting," although even after their discharge the receiving streams have concentrations of "pollutant" ions below natural levels in other streams?

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[10] For a history and summary of the Federal water quality laws see N. William Hines, Environment Law Review 1:282-348, 1970. The "standards" approach to regulation is described on pp. 317-324.

'Pollution' is an Incidental Consequence of Other Actions

The examples, converse instances, and borderline cases enable us to attempt answers to the following questions: What criteria can we apply to distinguish cases of pollution? Is there an empirical test that can be used to determine whether any specified event constitutes pollution? The statements quoted and examples given previously help to identify criteria we cannot apply. Pollution need not be technological (statement A, example 3), a list of substances or events which would constitute pollution whenever they are detected cannot be made (converse examples 1 and 4), and there need not be disease, damage, or death to man or any other organism (statement D).

Although we are unable to apply an empirical test to determine whether any event is a pollution episode, the use of the label "pollution" by an individual refering to an event tells us something about that individual and event. As was shown previously, we know that the individual considers the event undesirable. In addition, the examples presented indicate that the pollution event is an incidental consequence of some other occurence. "Incidental consequence" is used here, for although "unintended" can be used in cases of pollution by human agencies, it is not meaningful to speak of "intent" in cases of other organisms or abiotic events.

We can speak of animal pollution by metabolic wastes in terms of an incidental consequence of the waste-elimination functions of excretion. Even cases where a natural abiotic event is refered to as pollution (cf. converse example 1) can be considered as consequences of some other phenomenon. The oil pollution of Santa Barbara beaches contains a natural component: oil escapes from fissures in the sea floor, floats to the surface, and is washed ashore.[11] In this case the oil pollution is a consequence of the geological structure off Coal Oil Point. Whether the label "pollution" would be applied if there was no oil escaping from oil wells, tankers, and other installations and mixing with the natural oil is a moot point. Under present conditions it would be difficult to walk along the beach and say "this oil tar is pollution; this globule is from a natural soak." In fact, "the extent of natural seepage goes unnoticed by a majority of people along the coast of Santa Barbara County."[12]

The unintended nature of pollution caused by human activities can be seen in these examples: the industrialist does not run his factory to produce sulfur dioxide for release into the air; the driver does not run his motor vehicle to produce atmospheric hydrocarbons; the farmer does not spray DDT to cause infertility in raptorial birds; the housewife does not use detergents to increase the content of phosphates in the rivers and lakes; and the citizen does not flush his toilet to add nitrogen to the lakes and streams. In all these cases, pollution is a consequence of some "desirable" end.

To show that pollution is always an incidental consequence of some other action it is necessary to establish that deliberate pollution does not occur. Consider the deliberate addition of a harmful substance to some component of the environment; mustard gas to the air of a battlefield, for example. It would be most unlikely that the use of the gas, as a weapon, would be considered pollution, however distasteful its use may be. But mustard gas pollution could occur as an incidental consequence of its use to kill men at a particular time: other organisms might be destroyed; the region may remain uninhabitable after the war is over; and physiological changes could occur in the descendants of the survivors because of the exposure to this mutagen.

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[11] Alan A. Allen et al., Science 170:974-977, 1970.

[12] Ibid., p. 977.

Another case will help clarify this distinction between malicious intent and pollution. Imagine some feuding neighbours, one of whom deliberately fires his incinerator only when the wind will take the ash over his neighbour's washing hanging out to dry. His intent is to damage the clothing by causing soot to be deposited on the wet clothes. The damage to his intended victim's goods is much more likely to be labeled "vandalism" or "malice" than "pollution." But damage to the wash of residents two streets away, although physically indistinguishable from that to the intended victim's property, is likely to be called a consequence of air pollution.

The situation is analogous to a person taking deliberate aim at an adversary, but killing innocent bystanders who wander into the line of fire or who are hit by ricochet. Damage to the target organism is not pollution, but damage to the innocent victims is. (The force of this analogy can be seen by substituting DDT for the bullets, insect pests for the adversary, and raptors for the innocent bystanders.)

Two recent cases of the deliberate addition of pesticides to Ohio waters provide an example of the restriction of 'pollution' to the incidental consequences of a purposeful act, and the distinction between "pollution" and "malice." In the first case an ornamental lake was treated to control excessive plant growth. The newspaper report of the cessation of the treatment implies that it was the incidental addition of water to a stream into which the pond drained that constituted "pollution:"

> Physical Plant officials agreed Friday to stop spraying Mirror Lake with Hydrothol-47, a compound used to control algae and other aquatic plants. Daniel Goodman, a graduate student and research assistant in the Zoology department, claimed Hydrothol-47 is highly toxic and is polluting the Olentangy River as Mirror Lake water drains into the Olentangy.[13]

In the second case, reported under the headline "Poisoned Water Sealed Off,"

> State and Federal authorities /̄moved/ swiftly to head off possible dangers from poisons dumped into Pond Lick reservoir, . . . sealing off the 15-million gallon lake into which a gallon jug containing Endrin, a highly toxic pesticide, and strychnine was thrown June 2.[14]

In none of the subsequent articles in the two Columbus daily papers which reported the trial of the person responsible for this malicious act was the pond reported to be "polluted;" it was always refered to as "poisoned."[15]

The Information in "Pollution"

The brief sketch presented here illustrates two main points.

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[13] Ohio State Lantern, July 12, 1971.

[14] Columbus, Ohio, Citizen-Journal, June 12, 1971.

[15] Citizen Journal: June 14; June 19; June 25; and June 30. Evening Dispatch, June 11, 1971.

Firstly, when the label "pollution" is applied we know that the user considers that the phenomenon that he is describing is harmful, usually to man, but occasionally to other organsims. Secondly, we know that the phenomenon is an incidental consequence of some other action. But we do not know what by-product of the action is considered the pollutant, or what deleterious effects it is thought to have; nor can we empirically evaluate the truth of the claim that the event is an example of "pollution."

It might be objected that this analysis is knocking down a straw man, for "pollution" is rarely used in a totally unqualified manner. It usually appears in the form "pollution of A by X;" for instance, "pollution of air by carbon monoxide." However, when we try to translate this statement to read "the speaker considers that the addition of carbon monoxide to the air, a consequence of __________, is harmful, for it causes ___________," we are unsuccessful. The blanks cannot be filled from the knowledge that carbon monoxide has been called an air pollutant. In this particular case, we may fill the gaps with "automobile operation" and "physiological damage" because of our prior experience. Even then, we may not be sufficiently accurate--what physiological damage does carbon monoxide cause? Are automobiles the only relevant source of polluting carbon monoxide?

But the expansion of "pollution of the Tucson air by light," "social pollution," and "species pollution" is difficult, if not impossible, without access to the papers that use these terms.[16] The last two are made even more difficult by omission of any reference to medium or locality. 'Species pollution' could be interpreted as pollution of species, by analogy with 'air pollution'; or pollution by species, by analogy with 'pesticide pollution'. These examples effectively demolish the "straw man" charge, for they demonstrate that actual use of the label "pollution" conveys little substantive information beyond the implication that it is an incidental consequence of some action, and that the speaker considers it harmful or bad.

Unfortunately, there is a tendency to accept the evaluation of the speaker. This is the basis of the rhetorical use of "pollution" in political persuasion, but it does not form a sound basis for a rational educational program. To say that we are going to study pollution objectively is a contradiction in terms. The phenomena have been judged harmful before the study is commenced.

The argument presented in this chapter does not deny that "pollution" and "balance of nature" are useful rhetorical devices, which may help to win political and public opinion battles when used for their emotive impact. But to use "pollution" and "balance of nature" as descriptive terms in educational contexts where a rational approach is being advocated is an abrogation of the responsibility to consider the actual evidence of phenomena and their causes.

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[16] Robert J. Bazell, Science 171:461, 1971; Astride H. Esser, Social Education 35:10-18, 1971; Darrell D. Young, American Biology Teacher 35:286-288, 1971.

CHAPTER VIII

A CURRICULUM SEGMENT

A small sample of the type of curriculum content based upon the position outlined in Chapter Vl is given here. It is intended to illustrate the type of curriculum content that would occur for a program based upon the examination of the primary attributes of individual well-being. It is not complete, merely one segment of a larger curriculum outline that would be needed for a complete general education program designed in this manner. Data which could be used in the classroom are not provided in all cases. The omission is deliberate; in some cases the data base is not yet adequate and more reliable and/or complete data are being generated continually. In other cases local data are needed to facilitate instruction.

CONTENT

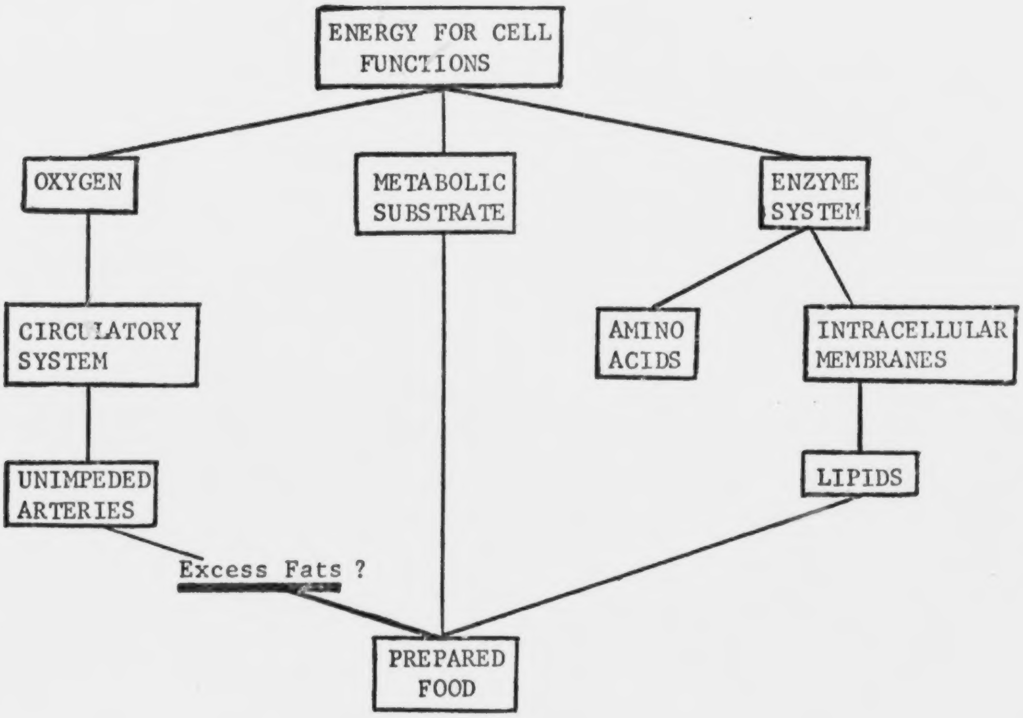
In Chapter VI it was shown that the most fundamental physiological needs were related to the supply of cellular energy. Three fundamental requirements were derived from this need: a supply of oxygen; a source of a substrate to be respired; and a functioning cellular enzyme system. Each of these requirements could be examined in detail, and, in a "complete" program, would lead to a complex interconnecting network of factors that should be considered. Figure 4 indicates in broad outline how each of these three important functions is connected at the position of the quality and quantity of food supply.

The Figure does not show all possible connections. For instance, a working circulatory system requires a functional enzyme system, and substances other than amino acids are needed for enzyme production. The Figure is only extended sufficiently to show that an exclusive concentration on a direct line from either oxygen supply, metabolic substrate, or enzyme system would ignore important interconnections.

For illustrative purposes, however, we will concentrate on topics that could be included in the fragment of a complete curriculum that considered the factors influencing the supply of metabolic substrates.

The amount and nature of the food available to an individual is affected by the production, distribution and storage, and final preparation stages. These three phases are common to all cultures, although the relative importance of, and the degree of human control over, each stage may vary. In nomadic food gathering cultures, for example, there is negligible human involvement in the production of food, and almost no effort expended in its distribution and storage. Contrast this with an industrialized, urban society. There are complex systems of agriculture, food processing and packaging. An individual only has control of the final preparation, and even that is being reduced with the advent of pre-cooked heat-and-serve foods. In this sketch we will

Figure 4



Partial network of interrelationships between factors needed to ensure a supply of energy for cell functions. Lines connecting the entries indicate a necessary dependence of the higher function on those below them. A bar on a line indicates a possible inhibitory relationship. (The "?" after the entry on the inhibitory bar indicates that there is still some uncertainty about the strength of the relationship.)

examine only the production stage of the food supply system.

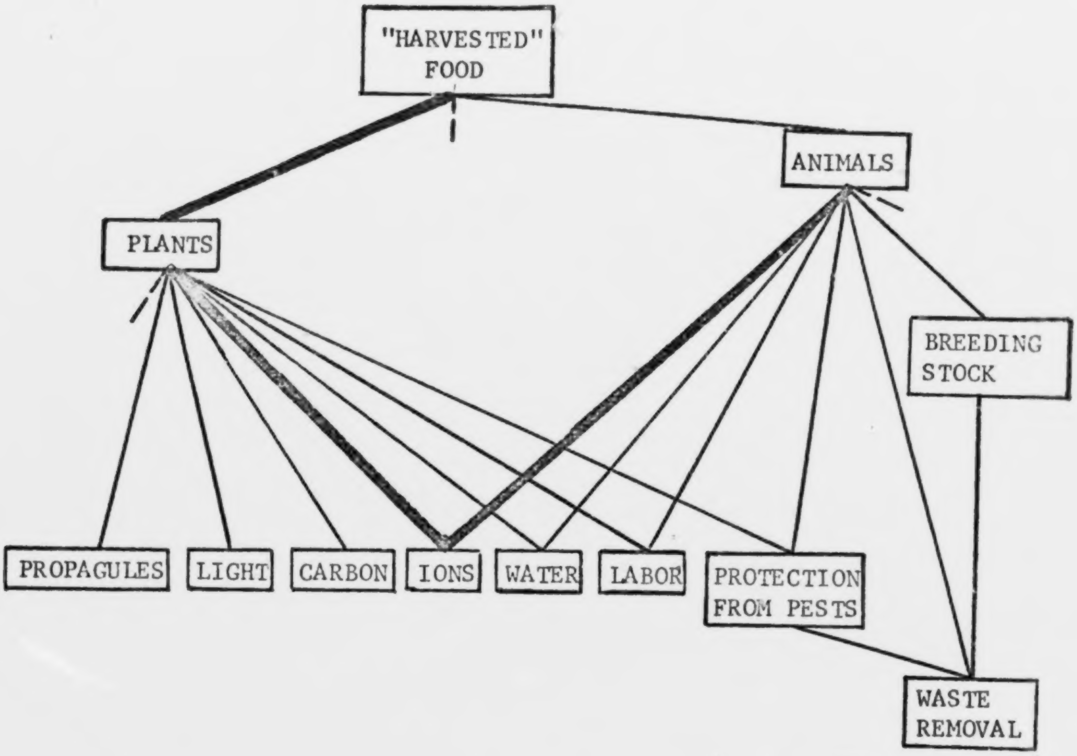
Requirements for Food Production

Figure 5 outlines some of the requirements for food production. Not all necessary requirements are included, (for example, the necessity for an energy supply for harvesting either plant or animal crops is omitted), but the complexity of the interrelationships is indicated even in this simplified diagram.

For our purposes we will take one of the prerequisites of harvested food and examine it in more detail. After a brief statement of the type of information that would be expected concerning the effects of ions on growth of plants and animals, and the effects the ionic composition of food may have on human health, alternate methods of satisfying the need for minerals are examined.

Ions. The discussion of this requirement should take into account the essential role of ions in plant and animal growth, i.e., the subject matter of traditional plant and animal physiology, and, in addition, the effects of the ionic composition of food on the health of individuals. The health aspects should include a discussion of the possible adverse effects on health of eating food with an unusual mineral content. The incidence of goitre, for example, was once associated with the regions where the soil had a low concentration of iodine, but the use of iodized salt has supplemented the natural supply and compensates for the lack of the element in the foods grown in those areas. (Widespread food distribution systems also tend to compensate for the mineral deficiency, for a person's diet is no longer restricted to food grown locally.)

Figure 5



Partial network interrelating requirements for the production of food for humans. The dashed lines indicate that other factors are also necessary. The heavy lines indicate pathways discussed in the text. The other conventions are as in Figure 4.

The possibility of plants concentrating an excess amount of a mineral deleterious to human health is more serious, for the possibility of easily removing these ions is remote. For example, there is a slight possibility that selenosis could occur in people whose diet contains a large proportion of food made from wheat flour produced from grain grown in the western United States, Canada, and Mexico, for soils in this region contain a high concentration of selenium, which is taken up by crops. In addition to the slight dangers to human health, selenium can cause "blind staggers" in animals that eat seleniferous plants, which may contain up to 5,500 ppm of the element.[1]

These examples indicate the type of content anticipated in programs based on our curriculum model. There should be an indication of the direct influence of environmental parameters on man, for example, the possibility of toxicity from a high content of selenium in the diet, and indirect effects, for example, the effects of soil deficiencies on plant growth. That is, every lesson or unit need not make direct reference to man. In fact, it may be advantageous not to slant all of the material toward man. To base the whole curriculum on man could, perhaps, tend to produce a feeling that man is somehow separate from the rest of the living world. But if sufficient biology, as distinct from human biology, is included in the program, it should become clearer that these effects on man are not unique, and that many of them are a reflection of general properties of living systems.

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[1] Alex Shrift, Annual Review of Plant Physiology 20:475-494, 1969.

Methods of satisfying the supply of ions are illustrated in Figure 6. Only one of the paths is traced out in any detail, but positions where other factors enter the system are indicated. The particular path considered in the text is indicated in the figure, and three of the factors on that path are described in some detail in the remainder of this section.

Virgin Lands--Managed Farms. The discussion of methods of meeting the requirement for a continued supply of ions for plant growth need not be restricted to the methods commonly employed in the local area. The principle involved may be more clearly shown by a comparison of alternate methods. In this case, the choice between virgin lands and managed farming would need to involve a study of the methods used by primitive agricultural societies, with their patterns of shifting agriculture; for example the slash-and-burn methods used by some Amazon basin aborigines. The effects of attempting to use that system in a modern society where not all people are farmers will be apparent to most students, for the time required for the land to regenerate its fertility will not allow sufficient food to be grown for larger populations.

Modern attempts to permanently clear tropical land now used in this manner should also be considered, paying attention to the losses involved. These losses are more than soil erosion and laterization; questions of the loss of genetic potential as plant species become extinct should also be raised.[2]

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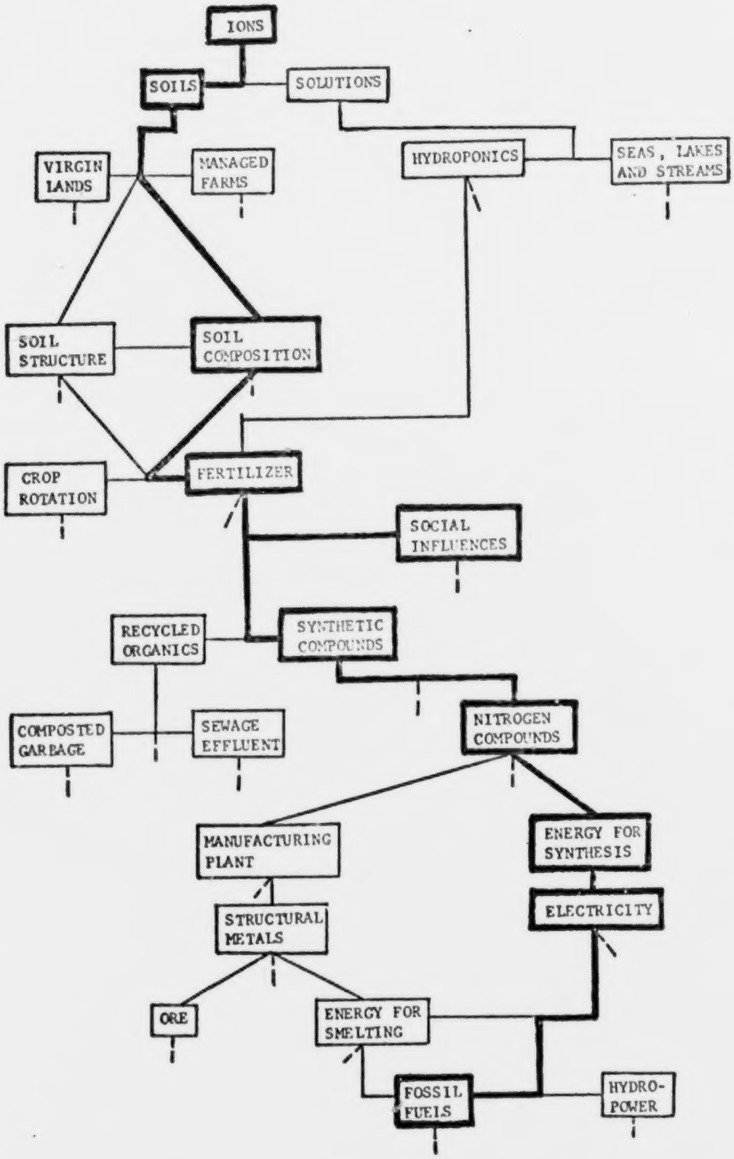
[2] A. Gómez-Poma et al., Science 177:762-765, 1972.

Figure 6



Partial network of interrelationships between factors needed to ensure an adequate supply of ions necessary for plant growth. Factors joined by horizontal lines are alternate, but not necessarily mutually exclusive, methods of meeting prerequisites for higher functions. Other conventions are the same as in Figure 5.

Suitable reference sources for this segment of a program include summary descriptions of shifting agriculture,[3] accounts of soil changes under widespread clearing of tropical forests,[4] and more detailed research studies of these relationships.[5]

The historical development of farming, including the development of crop rotation and fallow in Europe, the enclosure movement, the introduction of artificial fertilizer, and the modern farming practices that enable the same land to be kept in production more-or-less indefinitely could be used as a contrast to shifting agriculture.[6]

Added Fertilizer. As shown in Figure 6, managed farms require methods of maintaining soil fertility. "Fertility" has at least two components, soil structure and soil composition, particularly ionic composition.

If we examine the methods of maintaining ionic composition, we see that something must be added to the soil if all produce is sold from the farm. Unless all plants and animals growing in an area die and decompose in that area, the soil must become depleted. Eventually, reduced yields will occur. Thus some replenishment is necessary. Crop rotation that includes a leguminous species in the cycle can help to restore the concentration of nitrogen compounds in the soil, via the nitrogen fixing organisms that grow symbiotically with them, but other minerals cannot be replenished in this way. Some "outside" source is clearly needed if the same rate of production is to be maintained.

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[3] A brief account, together with extensive references, may be found in Institute of Ecology, Man in the Living Environment, Report of the Workshop on Global Ecological Problems (Madison: Wisconsin University Press, 1972), 173-183.

[4] Mary McNeil, Scientific American 211(5):96-102, 1964.

[5] The bibliography for Chapter 5 of Man in the Living Environment provides a recent starting point for studies of tropical forests, tropical savanna, temperate grasslands, and arid and semi-arid systems, allowing comparisons of "primitive" and "modern" land-use for food production. A detailed account of the variety of agricultural techniques found in a single region is contained in Marvin P. Miracle, Agriculture in the Congo Basin (Madison: Wisconsin University Press, 1967).

[6] G.E. Fussell, Farming Techniques from Prehistoric to Modern Times (Oxford: Pergamon Press, 1965) contains a broadly based account of the history of agriculture; for a more detailed description of the evidence upon which the interpretations of agricultural development

The outside source need not be a result of human activity. The periodic deposition of silt on the Nile delta and flood plains prior to the building of the Asswan Dam provides one example of replenishment of an agricultural area. Of course, this replenishment occurs at the expense of other, upstream, areas. In fact, some synthetic fertilizer use can be viewed as occuring at the expense of some other region. The use of rock phosphate or guano as a source of phosphate fertilizer clearly is effecting a redistribution of the material over the Earth's surface. These reserves will not last indefinitely, and the effect of their depletion on food supply should be considered as one facet of an analysis of this form of agricultural management.

The phosphate example is important, since, on a human time scale, the phosphorus cycle is essentially an open loop. Almost all of the Earth's phosphorus is bound as the phosphates of calcium,

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are based see Jaqueline Murray, The First European Agriculture: A Study of the Osteological and Botanical Evidence until 2000 BC (Edinburgh: University Press, 1970).

aluminum, and iron, all of which are sparingly soluble in water. Most of the phosphate leached from the rocks or added agriculturally is eventually precipitated into ocean or lake sediments. These sedimentary deposits are lost to agricultural systems, for they are returned to the terrestrial cycles mainly by the creation of new lands, by geological uplift for example.

It has been estimated that the upper limit of the supply of usable phosphorus materials (in rocks of at least 8 percent phosphorus) is 3×10^{14} tons. Known reserves have been estimated at up to 2.2×10^{10} tons; 1968 usage was estimated at a little over 1.1×10^{6} tons. Although the current rate of usage would not exhaust known reserves for about 1750 years, it is anticipated that population increase and increasing living standards will increase the demand. As a lower limit of the time to exhaustion of phosphorus, we can extrapolate present rates of increase of population and phosphorus use: presently known reserves would then be exhausted in the lifetime of some persons now living--90 years. /This is certainly too low an estimate, for it is unlikely that the growth rates will continue for that time: other factors are almost certain to intervene, either (optimistically) populations undergoing demographic transitions and decreasing their growth rate, or (pessimistically) mass famine and/or pestilence producing the same effect. Other factors could decrease the use of phosphorus./[7]

The depletion of phosphorus reserves will not cause the extiction of man, for there is sufficient leaching of phosphates from rocks that cannot be technically used as a source of fertilizer to maintain plant growth at a pre-fertilizer level. This level of phosphate availability has been estimated to be sufficient to maintain a human population of from 1-2 x 10^9 people.[8]

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[7] All data concerning the supply of phosphorus are taken from Man in the Living Environment, Chapter 3, particularly pp. 48-59.

The phosphorus case suggests good arguments for recycling of nutrients presently being lost in sewage and garbage from cities, and run-off from agricultural land, particularly the concentrated run-off from feed-lots. (This is one argument in favor of feed-lots that can be opposed to the argument that they are major contributors to stream contamination: it is much more likely that run-off from lots can be treated to recover the phosphorus than it is that the same amount of phosphorus could be recovered from wastes of the same animals on open range.) The phosphorus shortage also presents another argument against the use of phosphates as a base for laundry detergents: it is much too valuable to be used in this way.

Sewage treatment plants and the use of municipal garbage as a compost represent one method of reclaiming much of the phosphorus presently being lost. Other more novel methods of intercepting the phosphorus from these sources are being proposed and tested. For example one scheme that is under trial should be able to use almost all of the nutrients in sewage by growing algae in the effluent; feeding the algae to oysters which filter the water; using worms to scavenge the oyster droppings which would accumulate on the bottom of the culture tank; fish would eat the worms; and seaweed would utilize the nitrogen compounds excreted by the animals. Man would harvest the oysters, fish, and seaweed.[9]

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[8] Ibid., p. 42.

Thus, possible methods do exist for prolonging the part of the phosphorus cycle in ecosystems accesible to man. But it is doubtful that the recommendation in Brave New World will be implemented.[10]

In addition to the beneficial effects of adding fertilizer, and the long term difficulties in satisfying the demand for some fertilizer resources, deleterious effects of fertilizer use also need to be examined.

One of the commonest sources of problems is contamination of the run-off from fertilized land. The problem exists for most fertilizers, for some are inevitably lost by leaching. However, the potential for danger is greatest in readily soluble compounds, for these can easily attain a high concentration. Data on the actual and potential dangers of nitrogen, one of the major fertilizer components, are readily available. These dangers include loss of aesthetic satisfaction as algal growth in natural waters is stimulated by run-off "fertilization," (additional losses, for example, of fish production, occur, but there is also a large loss of recreational value); the possibility of infant methemoglobinemia following the reduction of excess nitrate in drinking water to nitrite in the digestive tract; nitrate induced gastroenteritis and diarrhea; and interference with the sulfur cycle by inhibiting the reduction of sulfate to sulfide, with a consequent lowering of the pH of soils and natural waters. These detrimental effects have to be considered in evaluating the use of fertilizers to increase food yield.[11]

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[9] A reference to experiments of this nature by Ruther (cited as "personal communication") appears in Man in the Living Environment, p. 234.

[10] Aldous Huxley, Brave New World (New York: Harper and Brothers, 1946), p. 86.

Data concerning the effects of inorganic fertilizers in water should be collected from more than one country or region, otherwise faulty generalizations may be drawn. In some countries with a higher use of synthetic fertilizer than the United States there is apparently little problem with the run-off in conditions of good husbandry. However, other differences also exist in these countries: in Britain, for example, there are no large lakes, and the shorter rivers are less likely to be slow moving. In this situation, there is a decreased chance of producing algal blooms that cause aesthetic and mechanical damage. (Note, however, that the differences in interpretation of danger from excess nitrates in drinking water may be a consequence of the application of different standards used to indicate a priori evidence of danger. The World Health Organization has set the level of risk of severe damage at 100 parts per million; some United States authorities allow only 10 parts per million in drinking water.)[12]

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[11] Man in the Living Environment contains a summary of the problems caused by the accumulation of nitrogen as nitrate in soil and water, (pp. 65-67), as well as a version of the nitrogen cycle based on changes in oxidation state. In addition to the sources cited in the bibliography for that section of Man in the Living Environment the following publication is a useful lead to the earlier literature: Kenneth M. Mackenthun, Nitrogen and Phosphorus in Water: An Annotated Selected Bibliography of Their Biological Effects (Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Water Supply and Pollution Control, 1965). Jesse Lunin, Advances in Environmental Science and Technology 2:215-261, 1972, lists over 90 related publications.

Government actions influence the use of fertilizers, and need to be at least considered in an examination of the influence on food production. These actions may be direct, via subsidies to encourage fertilizer use. Sometimes other government actions may tend to encourage fertilizer use, although it is not the intent of the policy. Schemes to reduce the "uneconomic" production of grain surpluses that encourage the removal of some land from production, but which do not limit the yields from the remaining land, may encourage the application of additional fertilizer to increase per hectare yield. Since there is a diminishing return on fertilizer application, a great deal of fertilize must be added to achieve increments in already high yields. (An empirical study of the relationship between increased yield and added fertilizer suggests that, on average, fertilizer increase must rise 2.7 times as fast as increased yield.)[13]

In addition to government actions favoring the use of fertilizer, some legislation and regulation may tend to inhibit the increasing rate of application. Laws on water quality may be applied to farmers whose run-off contributes to decreasing water quality with respect to inorganic ions. Commoner provides an undocumented report that State regulations to control the use of fertilizer were introduced by a member of the Illinois Pollution Control Board.[14] (A recent collection of the Federal laws related to water quality would provide a useful resource for United States students interested in examining the possibility of social sanctions, expressed through legislation, that may apply to accumulation of fertilizer in waterways.)[15]

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[12] Barbara Ward and Rene Dubos, Only One Earth: The Care and Maintenance of a Small Planet (New York: Norton, 1972), p. 92.

[13] Man in the Living Environment, p. 53.

Energy for Synthesis. Figure 6 indicates that we can trace requirements for food production beyond the necessity for some method of maintaining nutrients in the substrate used to grow plants. One of the factors shown in that diagram, "energy," will clearly be a major meeting place of many paths leading from the components of well-being. Even within paths related to the production of food it will occur a number of times--in the supply of power for cultivation, distribution, processing, storage, and final preparation, and in manufacture of the equipment needed at all of these stages.

In a practical curriculum energy supply need not be examined within every pathway, although it should be included in those pathways. Motivational and efficiency reasons mitigate against recurring treatment of the same topic. Teachers may decide to approach their curriculum by developing, or assisting students to develop, the interlocking systems of analytic pathways related to the prime components of well-being, and then choose to consider the major nodal points in some detail with all the students. They may then require or encourage individuals or groups to examine other pathways in more detail, using the techniques developed in a study of one of the common factors. Energy supply is one of the nodal variables that will allow a relatively clear cut model of techniques of examining other links in the pathways. Questions of the form used in analysis of energy supply could be asked about almost any other topic.

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[14] Barry Commoner, The Closing Circle: Nature, Man, and Technology (New York: Knopf, 1972), p. 92

[15] U.S, Congress, House, Committee on Public Works, Laws of the United States Relating to Water Pollution Control and Environmental Quality, 91st Congress, 2d Session, 1970. (Contains the text of six Executive Orders, twelve Acts, and five International Conventions.)

What are the possible energy sources? What are the advantages of alternate sources of energy when availability, net return on energy investment, and economic factors are considered? What are the disadvantages of each, when effects on health--immediate and long term, aesthetics, and the satisfaction of other components of well-being are weighed? If an "ideal" solution to the supply of energy is not presently available, which available alternative causes the least damage and keeps most options open? Although these general questions would be examined in a general consideration of energy supply, there are some additional ones that it would be necessary to pose for each specific instance of energy use in pathways leading to the enhancement of well-being. Can this function be satisfied with a mechanism that requires less energy? Can the energy "wasted" in the process be used in some other function?[16]

Data for an analysis of energy supply "needs" and alternatives are currently available in many places, and no attempt to weigh the alternatives will be made here. The following sources will provide a useful starting point for instructional planners seeking data concerning energy resources:

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[16] Ronald Stewart and S.P. Mathur, Conservationist 25(3):16-20, 1971, consider uses for excess heat from power plants.

> Man's Impact on the Global Environment: Assessment and Recommendations for Action. Report of the Study of Critical Environmental Problems. Cambridge: Massachusetts Institute of Technology Press, 1970. See pp. 288-306.
>
> The Energy Crisis. A Science and Public Affairs Book. Chicago: Bulletin of the Atomic Scientists, 1972. (An anthology of papers that originally appeared in the September, October, and November 1971 issues of the Bulletin, supplemented by additional papers.)
>
> Dean E. Abrahamson. Environmental Costs of Electric Power. New York: Scientists' Institute for Public Information, 1970.

These sources are mainly concerned with the technical characteristics of the alternate methods, and the technical aspects of their effects on other contributors to well-being. Some of the social effects are examined from a legal perspective in papers collected in Environment Law Review.[17] Economists' views on the techniques of regulation of some of the untoward affects from industrial processes in general, which may be applied to energy production in particular, are available.[18]

One further aspect of the social influence in controlling the emissions from power plants is related to the differences between cultures. Scorer contrasts the use of licensing authority under the British Alkali Inspectorate with what he regards as the unsatisfactory United States situation where the tendency is "toward making undesirable practices illegal and waiting for the possibility of prosecution to compel people to stop them." This philosophy, he claims, "invites arguments questioning the constitutional validity of stopping people doing what they have been allowed to do since time immemorial."[19] This technique also requires the establishment of technical criteria which "become standards of permissible pollution in so far as they are capable of having any real effect, and they support the concept that there exists a right to pollute the air at least up to the level of objectionable nuisance."[20]

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[17] See Larry J. Jost, Environment Law Review 1:463-481, 1970, for an account of the law relating to "thermal pollution;" Jeffrey Fromson, Environment Law Review 1:214-238, 1970, reviews the history of Federal air pollution control in the United States, including the regulation of power plants.

[18] See, for example, Richard A. Tybout, Bell Journal of Economics and Management Science 3:252-266, 1972; K. William Kapp, Kyklos 23:833-848, 1970; Wilfred Beckerman, Social Science Information 11:103-111, 1972; K. William Kapp, Social Science Information 11:113-124, 1972.

SKILLS

We have seen in earlier chapters that skills are a prerequisite for education for the environment. In the curriculum segment outlined here no mention has been made of skills, except the allusion to the information retrieval and intellectual analysis skills involved in assesing alternative proposals for meeting the requirements of well-being. It has been assumed that these skills are sufficiently generalizable that practice in analysis of sufficient pathways will promote transfer to new situations. This assumption needs to be tested empirically.

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[19] R.S. Scorer, Atmospheric Environment 5:903-934, 1971. p. 916.

[20] Ibid., p. 918.

Other skills that would be needed can be listed briefly, using the example of food production again. Some are clearly technical, and would not need to be objectives for general education courses. Engineering, agronomic, biochemical, economic, and ecological skills are clearly needed by some persons, otherwise the necessary data for evaluation of alternatives will not be generated. Practical "job" skills involved in farming, food processing, retailing, and food preparation are also needed by persons involved in the supply of food to the table, but these are also specific to the particular role played by each individual, and do not lead to objectives appropriate for a general education.

The appropriate skills needed by most people, irrespective of their occupational role, appear to be general political skills, needed to influence public opinion after a careful analysis of the data related to an issue has been completed. Of course, the generalized analytic and information retrieval skills are important components of this general ability, but, in addition, some knowledge of how to attempt to influence political authorities and public opinion is needed. This appears to be the skill that should be the goal of general environmental education.

CHAPTER IX

CURRICULUM IMPLICATIONS

In previous chapters we have examined the nature of 'environment' and 'environmental education', and have developed a rationale for an environmental education curriculum based on this examination. However, we have not asked whether an emphasis on environmental education is worthwhile. That is, is the development of environmental education curricula, programs and materials, likely to help restore and maintain a viable life-support system?

It is impossible to give a definitive answer to this question, for it depends upon whether the desired social ends are actually achieved. We can, however, examine some of the existing pressures toward the development of environmental education, and make some estimates of the most promising trends. These can be no more than estimates, and should not be interpreted as definitive statements.

Transdisciplinary Nature of Environmental Education

There is no necessity for a program to draw upon more than one academic discipline to count as an example of education for, about, and/or in the environment. However, as the sketch of a possible segment of an environmental education curriculum in Chapter VIII shows, a a program based upon the principles of Chapter VII cannot avoid drawing on several disciplines. In developing the sample concerned with the supply of food data from anthropology, history, plant and animal physiology, medicine, agronomy, ecology, geology, sociology, law, and economics were all necessary. This approach, directed toward the common purpose of enhancing the quality of the human environment through actions based on an understanding of the network of pathways leading to human well-being, fits the concept of transdisciplinarity proposed by Jantsch.

Transdisciplinarity, in Jantsch's terminology, is distinguished (by its pursuit of a common goal) from interdisciplinarity, which does not necessarily pursue a common goal, although in both trans- and inter-disciplinarity there is synthesis and coordination between disciplines concerned with common supra-disciplines. Multi-, pluri-, and cross-disciplinarity are characterized by a lack of coordination, although there may be cooperation.[1]

Educational programs proposed in response to the "environmental crisis" are often pluridisciplinary, rather than interdisciplinary or transdisciplinary. That is, various courses are juxtaposed in groupings that will enhance their interrelationships but no overall common purpose directs the courses or promotes interaction and coordination between them.

One example each of a pluridisciplinary and a transdisciplinary program will clarify the distinction. The original Environmental Quality Program of Hampshire College consisted of seven seminars: Chemistry and the Analysis of Pollutants; No deposit, No Return; Campus

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[1] Erich Jantsch, in Interdisciplinarity: Problems of Teaching and Research in Universities (Paris: Centre for Educational Research and Innovation, Organization for Economic Co-operation and Development, 1972), pp. 105-107.

Design; Explosion and Control; Man-Made Environment; Enzymes and Ecosystems; and Environmental Law. These were parallel programs, with a core lecture weekly to keep the perspective of environment before the students. They were not directed toward a specific common goal. This program exemplifies a pluridisciplinary environmental education. At the same college a transdisciplinary program evolved. In it students concentrate on understanding a particular system in order to effect change. For example, one project studied the Concord River, bringing chemical, biological, legal, and design skills to bear on a common problem; another used skills from a number of disciplines in a study of the urban environment in Holyoke, with the intent of providing the understanding and data needed by the local Model Cities program.[2]

The curriculum segment outlined in the previous chapter is not a concurrent treatment of environmental issues by a series of separate courses. It is transdisciplinary for it draws upon a particular discipline _when it is needed_ to provide skills or data required for an understanding of a particular problem. I did not _start_ with the disciplines and develop "environmental geology," "environmental biology," "environmental sociology," "environmental economics," and . . .

A corollary of the advocacy of transdisciplinarity must be kept firmly in mind. Separate disciplines will need to continue to exist, for at least at the research level there are certain techniques and intellectual skills which require specialist expertise. However, the specialist disciplines can, and should, be harnessed for transdisciplinary social and educational purposes.

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[2] Raymond P. Coppinger and Lorna L. Coppinger, in _Environmental Education: Academia's Response_ (Washington, D.C.: Commission on Undergraduate Education in the Biological Sciences, Publication 35, 1972), p. 69-70.

Courses in Environmental Education?

The transdisciplinary nature of education directed toward the enhancement of individual well-being by maintaining and improving the quality of the human environment suggests that it is inappropriate to concentrate on the development of curriculum materials specifically for a course in environmental education. This is particularly true in the case of monolithic curriculum projects of the type initially funded by the National Science Foundation to upgrade science instruction.

Projects aimed at producing texts, laboratory manuals, teachers' guides and associated audio-visual aids similar to the packages produced by the Physical Sciences Study Committee and CHEM Study are not viable as environmental education courses. Single, highly structured courses could not hope to provide an adequate rational approach to environmental education. A course of this nature could not provide the necessary social science and natural science background upon which students could draw in assessing alternate methods of satisfying the prerequisites of well-being in an individual's environment. The most that a monolithic curriculum could hope to provide would be predigested examples, analysed according to particular pre-selected concepts from the various necessary disciplines. Even the most successful course of this nature could not provide all the skills needed to draw upon the relevant disciplines when evaluating a newly arisen alternate method of satisfying some component of well-being.

Given this analysis, there is a need for supporting, and perhaps strengthening, the teaching of the basic disciplines, and for models of the way in which they can be used to evaluate the consequences, for human well-being, of proposed manipulations of environmental variables.

Descriptive "environmental" case studies, showing the ramifications of some specific actions; technique descriptions, ranging from simple methods of sampling particulate fall-out from the air to descriptions of techniques of public opinion determination; and materials to help teach the basic concepts of the relevant disciplines, all need to be provided.

These needs could be met in a number of ways. One possible method would be the preparation and distribution of single-concept modules from which the teachers could construct their own courses, and upon which the students could draw when they discover a need for a particular skill or understanding. Schools could plan their programs to provide the appropriate understandings in the special disciplines, and, in some type of general studies program, provide the necessary experience in selecting the principles of each field when evaluating proposals to solve "environmental problems" at the local, national, or international level. Selected modules could constitute a complete course within a program; alternatively, some might be used by teachers as supplementary materials.

Curriculum development, in the sense of preparation of materials for single courses called "environmental education" intended to be added to the course offerings within a school, is most unlikely to lead to a transdisciplinary approach. If environmental education has the same separate subject status as history, algebra, physics, and civics, even though it may contain some activities that "belong" in the other single discipline courses, it may not be viewed as a synthesis of the insights of these subjects. In the secondary school setting, transdisciplinary environmental education implies that a program is oriented toward a specific problem or set of related problems, and that each course in the program is directed toward the program goal. The program might be the total program of the whole school, or it may constitute a portion of the whole. That is, it is possible that a team-teaching approach based on the natural and social sciences for one grade level could develop to trace one or more of the paths leading to the satisfaction of individual well-being.

The necessary expertise in identifying, proposing, and testing possible solutions to problems may be given in a number of ways. Simulations of actual decision-making procedures may be useful to demonstrate the ramifications of political conflict, and, perhaps, in providing practice in finding data and presenting it to other groups. The simulations may be "role plays" based on actual situations, for example, "The Redwood Controversy" where players take the roles of senators, lumber industry spokesmen, conservationists, and other interested parties, and simulate Senate hearings and debates during consideration of the establishment of a Redwoods National Park.[3] Alternatively, the simulations may be based on a hypothetical situation, as in "The Planet

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[3] Frederick A. Rasmussen, "The Redwood Controversy" (Boston: Houghton Mifflin, 1971).

Management Game," where a team manages the resources of the mythical planet Clarion by deciding how the planet's development budget is to be spent; players become involved in balancing population, food supply, income, and environmental quality.[4] (Simulations may also be used for professional training purposes, not only general education. APEX simulates the conditions in a small city and is intended to provide experience for air pollution control personnel by means of role plays and computer simulations.)[5]

In addition to simulations, students may become involved in "environmental actions" in their own right, either by forming a quasi-political organization to press for local legislation to regulate perceived local actions that have an impact on the well-being of individuals, or via a more formal approach similar to Stapp's "environmental encounters."[6] In both these situations transdisciplinary study is almost mandatory if the group is to succeed in answering the questions posed by opponents to their proposals; the group must consider economic, social, scientific and technical, and aesthetic issues if they are to be convincing. Cases of actual involvement need not progress outside the school. Making decisions about school policy toward littering, or even the establishment of a dress code, will provide experience of political influence, and, almost inevitably, raise the difficult issue of enforcement. Students who have to weigh the issues involved in establishing policies, and providing mechanisms for enforcement, are at least likely to appreciate some of the difficulties faced by society-at-large.

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[4] Victor M. Showalter, "The Planet Management Game" (Boston: Houghton Mifflin, 1971). Descriptions of this game, "The Redwood Controversy," and two other games prepared for the Educational Research Council Life Science program can be found in Paul Holobinko, Frederick A. Rasmussen, and Victor M. Showalter, in Environmental Education: A Sourcebook, ed. Cornelius J, Troost and Harold Altman (New York: John Wiley and Sons, 1972).

[5] The computer simulation is described in APEX (Air Pollution Exercise) Volume 1: Game Director's Manual (Research Triangle Park, North Carolina: U.S., Environmental Protection Agency, Office of Manpower Development, 1971).

[6] William B. Stapp, Journal of Environmental Education 2(1):35-41, 1970.

The examples of involvement in an actual issue help to demonstrate one important point concerning the nature of transdisciplinarity. Each individual need not be equally competent in all disciplines to have an important impact on the success of the group working toward common goals. In addition to forming a framework for providing each individual with the minimum competencies in each discipline that are needed to enable its relevance to be seen, a transdisciplinary approach also gives an opportunity for each person to exercise interests and abilities that they may have. This is an important potential educational spin-off of pressing for transdisciplinary environmental education.

In programs prepared for an adult audience of the mass media a transdisciplinary planning base would also be useful. A conscious decision to base the program on a consideration of a transdisciplinary goal would not only ensure the representation of the diverse viewpoints of social scientists, including psychologists, political scientists, and ecomomists; natural scientists, chemists and biologists for example; and affected individuals; it would also increase the likelyhood of identifying gaps in the necessary data. Identification of these gaps, even if they did nothing else but provide the realization that actions are being taken in the absence of data, should be salutary. Recognition of ignorance may make us less likely to support actions proposed by an interested part without at least raising questions.

Recent Trends

Funds committed to curriculum development under the Environmental Education Act have not been used for large scale curriculum development in attempts to produce monolithic courses. Those funded for 1972 have typically been for relatively small-scale programs (the median grant for all projects funded under the Act, i.e., including those for community awareness, personnel training, and evaluation and dissemination, was $13,600; the mean was $18,544). Projects developing curriculum materials have been planned to provide sources of instruction on relatively specific topics: for example, the city as a waste producer (Sacramento, California); supplementary materials on demography (Population Education Inc., Washington, D.C.); river ecology (Hudson River Sloop Restoration, Inc., New York); watershed monitoring (Institute for Environmental Education, Cleveland, Ohio); air pollution simulation (Carnegie-Mellon University); and pesticide use (Oak Ridge Associated Universities). Many of the other projects listed are intended to provide supplementary materials for environmental education.[7]

Despite the misgivings of members of the Congressional Select committee on Education that an insufficient proportion of the funds is being spent on preparing curricula for environmental studies,[8] the present trend of funding from the Environmental Education Act appears to be satisfactory. That is, the type of project being supported promises to increase the supply of modules that could be used in parts of programs oriented toward environmental enhancement. Whether there are sufficient funds being allocated is a different question, but at least the pattern of funding seems appropriate.

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[7] U.S., Office of Education Grants for Environmental Education, 1972. Compiled by USOE Environmental Education office, (Columbus, Ohio: ERIC Center for Science, Mathematics, and Environmental Education, 1972).

The use of other Office of Education programs to support similar activities, and the involvement of other Federal agencies in the development of modules of the type envisioned is also occurring. For example, the Environmental Protection Agency funded the Tilton project that developed a series of activities concerned with water quality;[9] a program to assess "Solid Waste Disposal Alternatives for Maine Communities" was supported by the Higher Education Act;[10] and staff of the National Science Foundation have proposed supporting module development for environmental education programs.[11]

Each module produced for inclusion in the program described here need not, and probably should not, be transdisciplinary in nature. The modules should be prepared so that students can draw upon the materials needed to complement their existing knowledge and skills. Individual modules should be planned so that all disciplines are represented in the _set_ of activities available for a particular topic, but the inclusion of both economic and engineering information, for example, in one module concerned with the use of underground water for irrigation is undesirable. A multiplicity of disciplinary viewpoints in each module must reduce flexibility of learning approach; inevitably presents a preconceived view of the relationships between the disciplines; and is not as readily updated by revised information for one of the disciplines. The distinction between a transdisciplinary _program_ and unidisciplinary modular _materials_ should be maintained.

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[8] See comment by Representative Brademas in U.S., Congress, House, Committee on Education and Labor, Select Subcommittee on Education, Oversight into Administration of the Environmental Quality Education Act of 1970, 92d Congress, 2d Session, April 17, 1972, passim.

[9] Ibid., prepared statement of Tom Carrol, p. 50.

[10] Ibid., statement of Don Davies, p. 22.

[11] Greg. Edwards, NSF. Letter to Robert W. Howe.

If the use of funds to stimulate the production of a large number of units that can be used to supplement or up-date existing courses continues, and the basic disciplines are not neglected in favor of a total concentration on popular environmental topics, there is a good chance that the current emphasis on environmental education can make some difference to the physical and biotic factors that affect each individual United States resident. This is particularly true for the entire educational responsibility is not being left to the formal school years. Environmental Education Act grants are also being used to provide funds for public education programs;[12] we may hope that informed political support of needed change will occur even before the present generation of students forms a large proportion of the adult population.

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[12] _Grants for Environmental Education_, 1972.

The concurrent emphasis on other methods of effecting changes in the environmental parameters that influence individual well-being is encouraging. Technological advances in particle control devices have had an effect in reducing the amount of particulate matter from smoke stacks, particularly when supported by clean air legislation requiring the use of the appropriate technology. Environmental education programs are not being left to carry the major responsibility for environmental improvement. Education programs can, of course, be involved in providing a public climate suitable for legislative action. This is particularly true of educative efforts aimed at voters, and, although there is a danger of a group promoting an incompletely evaluated action[13] succeeding in influencing legislation to the extent that laws that may be detrimental to the long-term preservation of a quality environment are passed, a responsible use of the transdisciplinary model by public commentators should minimize this possibility.

The use of direct political and technical methods to influence environmental parameters removes the possibility of a charge against environmental education similar to those leveled against almost exclusively educational attempts to remove social and economic inequality: "if we want economic equality in our society, we will have to get it by changing our economic institutions, not by changing our schools."[14]

In addition to increasing the chances of achieving an environment conducive to individual well-being, the committment to direct action has a two-fold advantage with respect to the success of environmental education. Firstly, evidence is presented to students and other members of the public that at least something is being done, rather than being merely discussed--that is, there is evidence that at least some persons in power "practice what they preach." Secondly, data concerning the effect of various types of alternate actions are becoming available, and the public can see that some of the actions taken to reduce the incidence of heavily contaminated air, for example, do actually produce the predicted results.

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[13] See Chapter VI, pp.

[14] Mary Jo Bane and Christopher Jencks, Saturday Review of Education September 16, 1972, 37-42. p. 38.

Questions for Curriculum Developers

Any curriculum developer, whether he is the classroom teacher planning an instructional sequence or a specialist curriculum developer producing modules for adoption by teachers, has a number of responsibilities if he intends to produce curricula tagged "environmental education." These responsibilities include the normal ones of taking into account learning theories and the background of the intended audience, testing and evaluating the materials in some form, and attempting to provide alternate methods of instruction to suit different teacher/student combinations. When dealing with environmental education the developer must also clarify his positions to prevent confusion resulting from the diversity of interpretations of the terms "environment" and "environmental education." The analysis in this volume has suggested a mumber of questions which must be answered explicitly if ambiguity is to be avoided. These questions are collected in this section, together with a short summary of the arguments leading to the questions.

What Referent for 'Environment' is being used? The entity used as referent for 'environment' may vary. It need not be human, although in discussions of the environment it is invariably an individual person or group of people. The group may be of any size, from the family to the species. The curriculum developer needs to specify with which of these possible entities he is concerned. Although the examples given in the text have been based on the environment of individual humans, this is not the only viable position. If a different position *is* taken, using a human *group* as the referent, the possible implications of this position need to be recognized. The possibility of a consideration of the environment of the species leading to actions incompatible with value systems that emphasize the dignity of each human has been discussed in Chapter III, (pp. 58-66). These issues should be kept in mind when preparing materials or planning a program.

What is the Purpose of Preparing Environmental Education Curricula? The purpose of offering environmental education affects the type of material to be included. This arises because not all parts of the literal environment of the entity chosen are relevant for all purposes. Although it is rarely explicitly stated even in formal discussions the purpose can often be inferred from the descriptive qualifying term used: the *social* environment, the *cultural* environment, the aesthetic environment, and the *institutional* environment are all used in the literature and all imply a different purpose of studying and, perhaps, manipulating environmental variables. Once the purpose is known or inferred, the relevance of a parameter can be determined by answering the question "Does this component of the total environment of the entity being considered have an effect, or a potential effect, related to the purpose?"

There is one exception to this simple criterion. When identifying components of the total environment of an individual human that form part of _the_ environment it is also necessary to show that exposure to the factor being considered is both unintentional and inevitable if a person is in the appropriate geographic region. (Other people are not normally considered part of _the_ environment, although they meet these criteria.)

Faced with these possibilities the curriculum developer needs _at least_ to specify the qualifying terms he is using with "environment;" ideally the purpose for considering environmental variables should be explicitly stated, and not left for the reader to infer.

Which Class of Environmental Education is Appropriate? The decision concerning the purpose of studying environmental education will partially determine the class of environmental education program to be developed. The goals may be to produce a knowledgeable individual, in which case a program of education _about_ the environment will be developed, or the aims of the program may be to enhance the quality of the environment leading, for example, to increased chances of individual well-being. If the aims are of this second type the curriculum developer will attempt to produce a program _for_ (the preservation of) the environment. He may, and almost certainly should, wish to provide a knowledge base from which students can draw in addition to the essential skills that must form a basis for programs _for_ the environment.

If this is so, he will prepare a program that fits the characteristics of the combined class 'education about and for the environment'.

An empirical decision will have to be made concerning the worth of the pedagogic technique education in the environment. In many cases the provision of practical, concrete experience with the "real world" will be effective in motivating learners or assisting in the development of concepts, but there is no absolute necessity for instruction to be outside the classroom for it to count as "environmental education." Indeed, the curriculum developer needs to look very carefully at the position he may be conveying to students if he insists that all data concerning the environment must be gathered at first hand.

The curriculum segment developed in Chapter VIII is an example of education for and about the environment that is based on the assumption that it is not appropriate to attempt to inculcate specific attitudes toward an array of "environmental issues." Instead, the position that students should be encouraged to develop a generalized rational attitude is advocated. That is, the program can be considered successful if citizens ask questions of the form "What is the evidence that the proposed action will have no deleterious effects?" "What is the balance of positive and negative effects on well-being of these actions?" "Is there an alternate method of satisfying the need, and if so, what are the comparative costs and benefits?"

Should Emphasis be placed on Courses or Programs? The generalized rational position leads to the possibility of a transdisciplinary base for education, and curriculum developers should examine the possible implications of developing courses based on specific examples of social problems and hoping that this approach will provide a sufficient grounding in the necessary disciplines to enable citizens to ask the appropriate specific questions when new problems arise.

It is, however, necessary that all students have the experience of drawing upon the appropriate disciplines when a particular issue is being considered. One example of the types of questions and alternative positions that need to be considered in this approach is given in Chapter VIII, and, in this chapter, some recommendations concerning the place for such a discussion are given.

The curriculum developer needs, therefore, to ask two types of questions concerning his program. Firstly, are the appropriate basic skills being provided so that students may ask the correct questions, (and understand the answers), when confronted with a new issue? That is, are future citizens being given a sufficiently strong base in the social and natural sciences and the humanities? Secondly, are opportunities being provided for synthesizing data derived by applying the concepts and techniques of the various disciplines to specific questions?

If the curriculum developer provides specific answers to these questions, and if critics clarify the positions which these questions are designed to elucidate before attacking any environmental educator's position, the abundance of definitions of "environment" and of "environmental education" will cause few problems. If these positions are not clarified, discussion of any particular program claiming to be an instance of "environmental education" is likely to be confused.

Asking these questions is also likely to direct discussion to more profitable lines--consideration of the details of goals and instructional programs rather than attempts to redefine "environment" to suit a particular concept of education.

Justification

The congruence of educational and social actions augurs well for the success of activities designed to enhance the quality of the environment of each individual. It is by no means certain that the goal will be achieved, but there are some promising indications that at least some of the objectives are being met. Some potentially harmful actions have been halted while data were gathered on the possible side effects of the proposals, for example, the trans-Alaska oil pipeline. Although economic factors may have played a role, the development of the United States version of a super-sonic passenger jet (SST) was stopped at least partially because of the evidence presented concerning the possibilities of deleterious change in the world climate. The risk was not taken despite the lack of firm conclusions: "due to uncertainties in the available information and its interpretation, we cannot be certain about the magnitude of the various effects."[15]

Citizen action has also produced some desirable changes. For example, a proposal to raise about $2,000,000 p.a. from local taxes to buy and maintain open space was approved by the voters in Jefferson

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[15] Man's Impact on the Global Environment: Assessment and Recommendations for Action. Report of the Study of Critical Environmental Problems (Cambridge, Massachusetts Institute of Technology Press, 1970, p. 107.

County, Colorado, in the 1972 general elections.[16]

Although actions such as these may not be the direct result of environmental education in any of its senses, the prospects of increasing support by informed individuals for private and governmental actions is a strong justification for the development of transdisciplinary programs focussed on the relationships of components of an individual's environment to his well-being. Provided that environmental education is not expected to be a panacea, with other direct methods of preserving a supportive environment being forgone in favor of educational expenditure, it is worth supporting. Even if it cannot be shown that environmental education is ever responsible for any environmental enhancement, the expenditure will have been worthwhile if it increases the contact between the various school subjects. Although this may seem a trivial achievement compared with the perceived magnitude of the "environmental crisis" the destruction of strictly compartmentalized subject teaching by encouraging each discipline to contribute toward the achievement of a common goal should have far reaching educational effects which may continue even if the immediate social goal of improved well-being is achieved.

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[16] Time, November 20, 1972, p. 18.

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